CITY OF CAPE TOWN FOOD SYSTEMS SCENARIO ANALYSIS FINAL REPORT

Charles, Andrew;Battersby, Jane;

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City of Cape Town

Food Systems Scenario Analysis

Final Report

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Ove Arup & Partners Ltd
13 Fitzroy Street
London
W1T 4BQ
United Kingdom
www.arup.com

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Contents

1 Introduction

Cape Town has a complex food system, characterised by interactions of formal and informal actors along the entire supply chain. Arup has been commissioned to conduct research into the food system of Cape Town in partnership with African Centre for Cites' (ACC) food systems specialist Jane Battersby-Lennard, for the City of Cape Town (CoCT). The City seeks to ensure that a resilient supply of nutritious low-cost food is maintained within Cape Town in the face of current stresses and future shocks.

1.1 Context

The food system in Cape Town is a major contributor to formal and informal employment, food security, health and social cohesion. It is a significant user of the energy and generator of traffic congestion and solid waste within the city. There are many potential interpretations of resilience in the food system. In the context of this report and aligned with 100RC's definition of city resilience, **the resilience of the food system is defined as its capacity to ensure the supply of food to all residents of Cape Town, in the face of any shock or stress and to deliver multiple benefits across interdependent systems, such as education and health.**

Like other cities in South Africa, Cape Town has high levels of food insecurity. As part of the Preliminary Resilience Assessment[1], the City has identified food insecurity as a key stress for poor and vulnerable Capetonians, particularly those living in informal settlements. In addition, the City has identified climate change-related shocks, such as drought as a further challenge and critically important to Cape Town's overall resilience.

The South African National Health and Nutrition Examination Survey (SANHANES) found that 32% of residents in urban informal areas experienced hunger, and a further 36% were at risk of hunger (Shisana et al, 2013). However, food insecurity is not just a problem in informal areas. The Bureau for Food and Agricultural Policy (BFAP) 2012 calculation of the income required to feed a household of a "balanced daily food plate" was R5630 (BFAP 2012, 49). According to Census 2011, 61.5% of Cape Town's households earn less than R6 400 per month. Food insecurity needs to be understood as being caused in part by challenges and opportunities in the food system but also within other systems in the city, which make healthy foods unaffordable for most of the population. Plans to ensure food system resilience must work towards resilience, not just in terms of maintaining the status quo, but generative resilience.

Finally, it is important to note that elements of Cape Town's food system extend beyond the administrative boundaries of the City and that the CoCT has both

[1] https://resource.capetown.gov.za/documentcentre/Documents/City%20research%20reports%20and%20review/CCT%20PreliminaryResilienceAssessment.pdf

direct and indirect mandates shaping components of the food system operating within its jurisdictional boundaries.

1.2 Approach

The aim of the research study is to understand the potential impacts on the resilience of the food system and to identify key opportunities to enhance the resilience of the food system.

Specifically, desk-based research was carried out to provide the following:

- Review of the existing data available online and through the ACC (including data on the informal sector) to support scenario analysis[2];
- Assessment of three scenarios selected by the CoCT:
  A. Whole system flooding (short term);
  B. Civil unrest (short term); and
  C. Transport network resilience (long term).
- Identification of key opportunities for Cape Town to increase the resilience of its food system.

The research was carried out in 5 key steps as illustrated in Figure 1.

1. Understand the Cape Town food system
2. Create a tool in GIS to visualise the system
3. Define the resilience scenarios of testing
4. Determine and analyse the scenarios and the food supply chain impact / impairment due
5. Identify opportunities to build resilience. Opportunities focussed on short and medium-term opportunities and that are realistic within the existing social, economic and environmental realities of the City of Cape Town.

[2] Note: No food systems map exists for Cape Town. The research team had to develop a bespoke tool to visualise the Cape Town food system in GIS before reviewing the different impact scenarios.

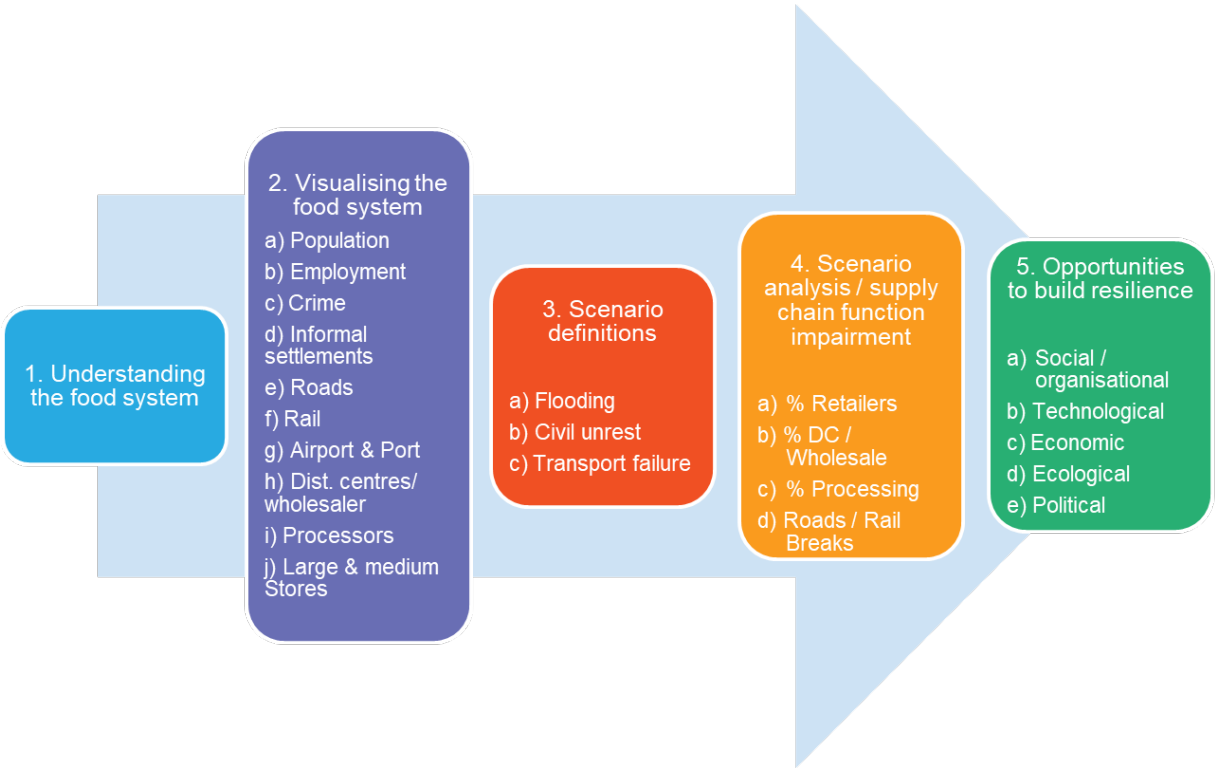


Figure 1 - Task Approach

1.3 Report Structure

The report is presented in 6 sections.

Section 1 – Introduction – understanding the context of food resilience challenges in Cape Town, the research aims and approach.

Section 2 – The food system – this section provides an overview of the current food system in Cape Town, how Capetonians interact with this system and a discussion on the role of City within the food system. This provides the context for the scenario analysis that follows.

Section 3 – Visualising Cape Town's food system – provides a description of the data collected to construct a GIS visualisation tool that was used to review the impact of the identified scenarios.

Section 4 – Scenario description – this section presents the 3 scenarios and discusses how they were identified.

Section 5 – Scenario analysis – this section provides a summary of the scenario analysis and identifies gaps in the food system and define specific opportunities for each scenario.

Section 6 – Key opportunities – this final section identifies overarching opportunities to be considered within the CoCT Resilience Strategy to enhance the food system resilience of Cape Town.

2 The food system

This section describes the current food system in Cape Town. A food system can be defined as *a system comprising (i) the activities, actors and institutions who grow, process, distribute, acquire, consume and dispose of food and how they interact with other systems and actors; and (ii) the outcome of these activities contribute to overall food security (Adapted from Roberts 2001, Ericksen 2007, and MacRae 2013).*

2.1 Food production

There are no reliable figures on what proportion of Cape Town's food comes from Cape Town or its functional city region. Research conducted for the City in 2013 using estimated national consumption figures and data from the agricultural census (which only holds data on a limited number of crops grown on commercial farms) estimated that production of onions, carrots and cabbages from commercial agricultural areas in and around Cape Town accounted for almost a quarter (23.9%) of the city's required vegetable tonnage, and that local potato production was the equivalent of 38.1% of Cape Town's annual potato consumption (Battersby et al 2014, 97). According to the Agricultural Census only 15% of the productive agricultural land (calculated on hectares planted) is dedicated to vegetable production (the remainder being grapes and apples) (Battersby et al 2014, 94). This land is key in producing staple vegetables for Cape Town and is a vital component of the food system's resilience. Interviews conducted with farmers in the Philippi Horticultural Area, a major vegetable producing area in the city, found that around 80% of the farms' produce went direct to retail, about 12% went to Cape Town Fresh Produce Market (CTFPM) and about 2% went straight to the informal trader network.

The agricultural landscape around Cape Town is highly export oriented. The Western Cape produces 21% of national agricultural production, but 45% of all agricultural exports.

Cape Town has a large number of household and community urban agriculture practitioners. The City has had an Urban Agriculture Policy since 2007 and a Food Gardens Policy since 2013. The Provincial Department of Agriculture runs a Farmer Support and Development programme. There are also a number of NGOs supporting urban agriculture practitioners, with some market support being offered (Abalimi's Harvest of Hope and Umthunzi Farming Community being the most significant). There is, however, no reliable data on levels of production from these farms or contribution to food security.

2.2 Food processing

South Africa has a highly consolidated food system:

> *"About 70% of agricultural output is used as intermediate products in manufacturing and related sectors (Louw et al. 2007:4). There were more than 2 200 companies involved in food and beverage manufacturing in 2003 (Vermeulen et al. 2008:200). But the food and food products sector*

> *is one of the most concentrated sectors in South African manufacturing. Between 1975 and 1996, the contribution to output of the top 5% of firms increased from 65% to 75%. The top 15% of firms had 90% of output in 1996 (Louw et al. 2007:14). A few large corporations dominate the South African food industry: National Brands, Pioneer Foods, Tiger Brands, and Nestle SA." (Greenberg 2010, 11).*

The City commissioned Food System and Food Security Study analysed a list of 616 licensed food processors provided by the City. According to the dataset, all but three of the top 10 packaged food companies in South Africa have processors in Cape Town:

> *"Tiger Brands is present through Albany, Beacon Sweets and Chocolates, Jungle Oats, Jungle, Tiger Brands Mayonnaise (Cross & Blackwell), Tiger Brands - Jarred Baby Foods (Purity), Tiger Milling, and Tiger Brands - Cereals.*
>
> *Pioneer Foods is present through factories of its Sasko and Bokomo Brands.*
>
> *AVI is present through its I&J Brand.*
>
> *PepsiCo is present through its Simba Chips brand.*
>
> *Parmalat, Clover and Dairybelle are all present in factories listed under the company name.*
>
> *Nestle, Unilever and Cadbury appear to be absent from the City's database, Nestlé's website states that they have a pet food factory in Ndabeni and a culinary factory in Bellville (http://www.nestle.co.za/aboutus/countryoffices).*
>
> *Unilever has 14 factories in five areas in South Africa, the nearest to Cape Town being Stellenbosch" (Battersby et al 2014, 176).*

The City of Cape Town does not hold data on volumes produced by processors, or where the food produced goes post-processing. **However, the spatial data generated provides indications of clustering in food processing and therefore potential locations for resilience building strategies.**

2.3 Distribution centres and wholesalers

Fresh Produce Markets are an explicit municipal competence in the Constitution and are therefore a key point for food systems governance. Cape Town's fresh produce market was privatised in 2004. The Market, like other municipal markets nationwide, has seen a reduction in volumes of trade, because of supermarkets increasingly having direct contracts with farmers. However, the Fresh Produce Market remains a key site of fresh produce purchase for informal traders. Potatoes South Africa estimate that informal traders accounted for 53% of all fresh potatoes sold at fresh produce markets (DAFF 2012).

The supermarket distribution centres are major components of the food system. Supermarkets account for almost 70% of all grocery sales in South Africa

(Planting 2010). Four major companies account for 97% of sales within the South African formal food retail sector. Shoprite Checkers currently controls around 38% of the formal food retail market, followed by Pick n Pay at around 31%, Spar with around 20% and Woolworths with around 8% (GAIN Report 2012). These stores have highly centralised distribution systems. For example, Pick n Pay state that 68% of their inventory goes through their centralised distribution centres (DCs). Pick n Pay has two large distribution centres nationally, one is in Cape Town – in Philippi. Spar's Cape Town Distribution Centre is across the road from the Pick n Pay DC in Philippi. Shoprite has recently opened a new 123 000m2 DC in Brackenfell and Woolworth's is in Montagu Gardens.

The informal trader networks source food from a variety of wholesalers, with important locations being the Makro stores in Ottery, Montagu Gardens and Cape Gate, and smaller wholesalers/cash and carry stores in key locations such as Philippi and Bellville.

2.4 Food sector logistics

Although there are no reliable figures on what proportion of Cape Town's food comes from Cape Town or its functional city region, an element of resilience comes from the operational strategy of the retailers.

The main national retailers follow a typical model whereby manufacturers from across South Africa feed into regional distribution centres that supply the local retailers. Distribution networks supply a significant amount of the informal and well as formal food system.

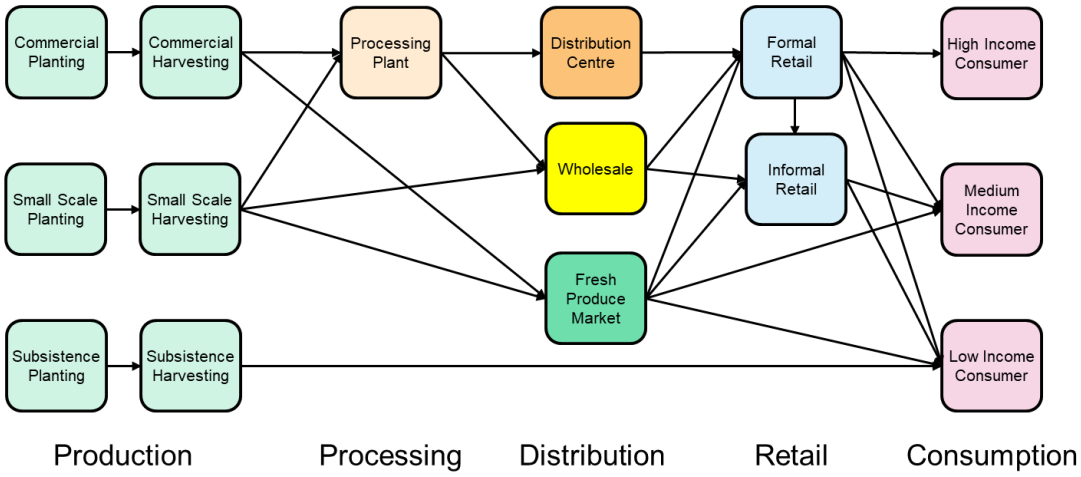


Figure 2 – A simplified schematic of South Africa retailer supply chain

Under this typical model - in the event of a shock to the supply chain - disaster recovery processes will adjust the volume of stock delivered to retailers (e.g. supermarkets) based on those which are still operating. Similarly, if any distribution centres are compromised or cut off from their normal retailers, those retailers will be supplied from other distribution centres in the network, and orders

to replenish the distribution centres will be similarly adjusted to consider the change in expected demand across the retailer's local network.

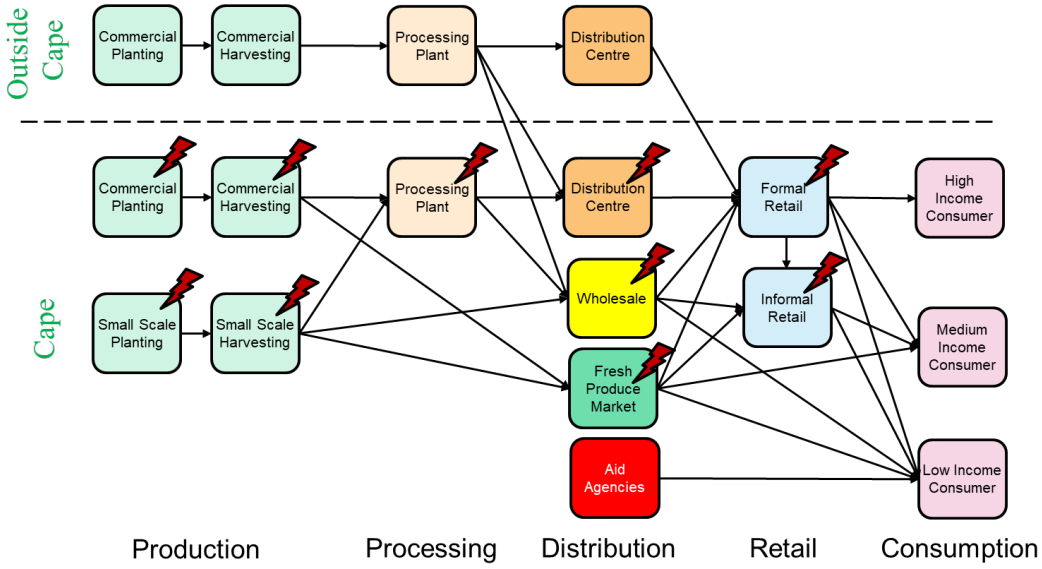


Figure 3: Retailer supply chain during a shock scenario

Clearly a significant disruption to food processors, distribution centres and wholesalers will have an impact on the food system and may disrupt the supply of certain commodities, such as short shelf life staples like bread. However, the ability of the retailer and wholesaler supply chain to maintain significant food deliveries despite disruption will be preserved unless a very large proportion of the processors, distribution centres, wholesalers, markets and retailers are impacted.

The situation for informal retailers may be different and is explored further in the scenarios that have been examined below.

2.5 Retail sector

Cape Town's food retail sector is characterised by formal chain supermarkets (dominated by Pick n Pay, Shoprite, Spar, Woolworth, Food Lovers Market and their subsidiary stores e.g. Boxer), a smaller number of locally owned chain supermarkets (e.g. Goal), smaller independent formal stores (superettes) and a range of informal retailers (Spaza, fruit and veg stands, meat stands). The major supermarket chains account for 97% of formal food retail in South Africa. There has been a rapid increase in the number of supermarkets in Cape Town increasing 2.6 times, from 89 (1994) to 235 (2012) – equivalent to 8 new supermarkets every year since 1994. At the same time the city's population has increased 1.5 times between 1996 and 2011 (Battersby 2017). There has also been an expansion of supermarkets into lower income areas of the city, mainly in the form of shopping malls in which a supermarket is an anchor tenant. South Africa currently has the fifth highest number of shopping centres of any country in the world (ICSC Country Fact Sheet 2015 in Prinsloo, 2016).

An estimated 30% of food retail takes place through informal vendors. There is no city-wide data base of informal food retailers, and this report is therefore dependent on case study material. Research conducted in two wards, one in Philippi and one in Khayelitsha conducted in 2013 found 492 informal food retailers operating in the two wards. Of these 80% were either general dealers/spaza/tuck shops (39%), meat traders (20%) or fruit and vegetable traders (19%). There were distinct geographies of trade with dense retail of prepared foods around transport interchanges, concentrations of fresh produce traders near sites of formal retail and spaza stores spread evenly throughout the wards (Battersby et al 2016). Train stations and taxi ranks are important sites of food trade throughout the city (Park Ross 2017). Informal food retail is most concentrated in low-income informal settlements, but also remains present in low middle-income areas, such as Upper Manenberg (Cooke 2012).

2.6 Food waste

No city scale data is held on food waste. Nahman and de Lange have analysed food waste in South Africa along the food supply chain according to different categories of food. As the Food System and Food Security Study for the City of Cape Town notes, “Food processing and packaging is a predominantly urban activity, and through the presence of the CTFPM there is a concentration of post-harvest handling and storage in Cape Town. Furthermore, the city is a major site of retail and consumption. It is clear that there is substantial food waste within the city. This is a sustainability challenge and opportunity.” (Battersby et al 2014, 201).

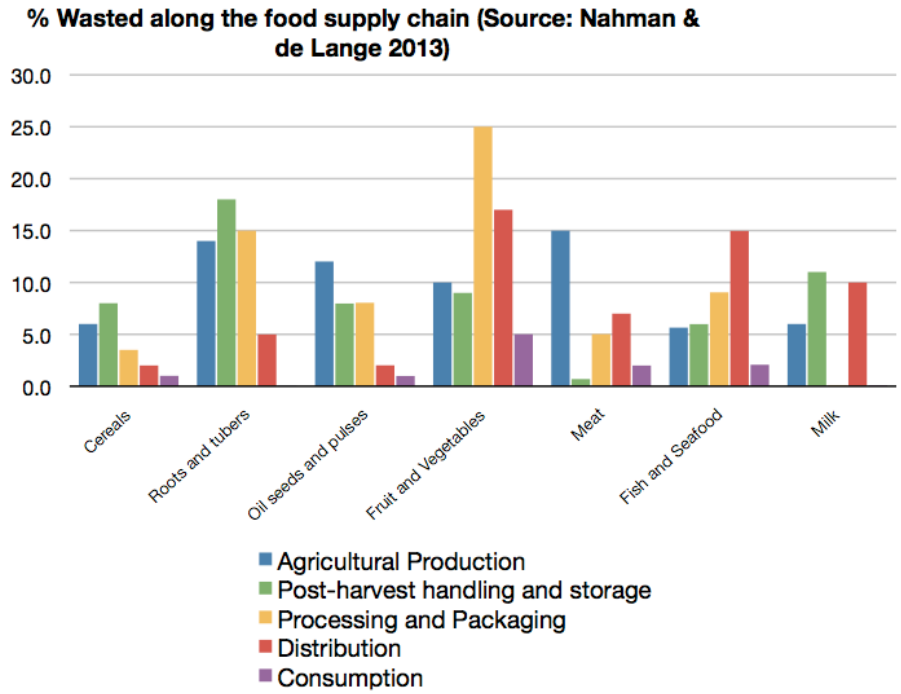


Figure 4: Waste along the food supply chain in South Africa

In comparison, the percentages of waste in high-income countries are skewed more towards consumption.

2.7 Consumption patterns

The final component of the food system is consumption. As noted above, there is significant food insecurity in Cape Town, and yet households are able to maximise their potential food security through exercising agency within the bounds of the system. For example, households will engage in outshopping (shopping outside their residential area) to obtain cheaper or better-quality food. They will buy food from a range of food retailers to meet their needs according to their household income level. They will engage in consumption smoothing – reducing dietary diversity for example – to ensure a constant supply of basic food for the household. Finally, households draw on social networks to access foods in times of crisis.

This provides a buffer against shocks in the food system. This resilience can be eroded by the reduction of individual agency, such as poor access to transport, poor access to household assets (such as storage and refrigeration), and loss of household income. **Strategies to enhance food system resilience should therefore consider the resilience of end users of the food system as part of the plans to enhance systemic resilience.**

3 Visualising Cape Town's food system

No map of Cape Town's food system exists. The following is a description of the spatial data that was collected through a desktop review of available open-source information combined with specific research available through the ACC that was used to construct a set of GIS data. The GIS data is used as the central tool to visualise Cape Town's food systems, and to review the impact of the identified scenarios on the city.

The following data has been collected to establish the visualisation tool:

- Transport network (road, rail, sea and airports)
- Population information (population distribution, employment, informal settlements, and crime statistics)
- Food infrastructure (distribution centres and wholesalers, formal/informal retailers, food processors, and producers)
- Flood data

3.1 Transport Network

3.1.1 Road network

A detail layout of all of Cape Town's roads was sourced from the City of Cape Town (2013). The Primary and Secondary roads were created as separate layers by using the Cape Town Transport Strategy as a reference (City of Cape Town Transport and Urban Development Authority, 2018). The strategy in question uses a combination of mobility and accessibility to distinguish between the two types of roads. It is for this reason that some roads which may appear different in terms build and capacity, fall into the same category. All other none primary or secondary roads are then designated, by default, as tertiary.

Figure 5: Primary and secondary roads

Figure 6: Primary, secondary and tertiary roads

3.1.2 Rail network

The Rail network was extracted from a larger layer that consisted of South Africa's entire rail network (MapCruzin, 2014). This original layer was trimmed down to retain the rail routes within the Cape Town boundary, as well as the directionality of their origins outside of boundary.

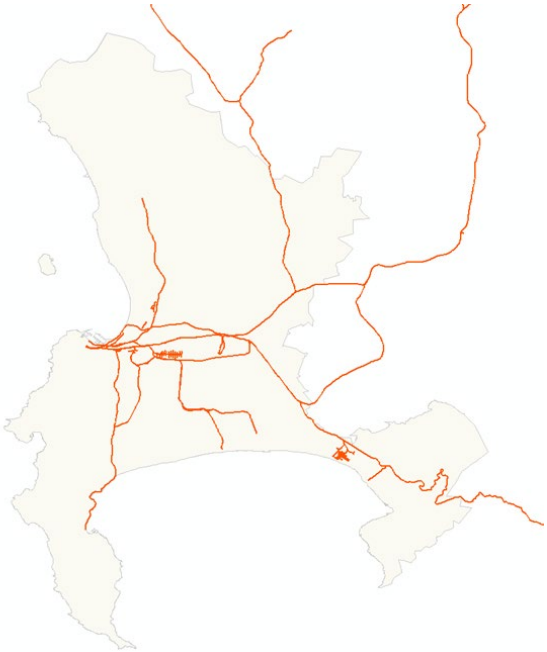


Figure 7: Cape Town rail network

3.1.3 Sea and Airport

The latitude and longitude coordinates of both Port of Cape Town and the Cape Town International Airport where taken from Google Maps. These coordinates were imported into ArcMap to form part of the GIS.

Figure 8: Port and airport locations in Cape Town

3.2 Population Information

Population information is relevant to the food systems tool as it displays where there are concentrations of consumers and the where poor and vulnerable population are located.

3.2.1 Informal Settlement

The spatial data on informal settlements is taken from openAFRICA (2015). This dataset was last updated in November of 2015. There are around 146,000 households in 437 informal settlement pockets in Cape Town - 204 are recognised as informal settlements (ismaps.org.za). While 4 years old, this data set is the not considered to have changed significantly as many informal settlements were established before democracy. The dataset will enable an accurate GIS analysis of key areas of socioeconomic vulnerability within the city.

Most of the informal settlements are shown on the map below (some are outside the area shown):

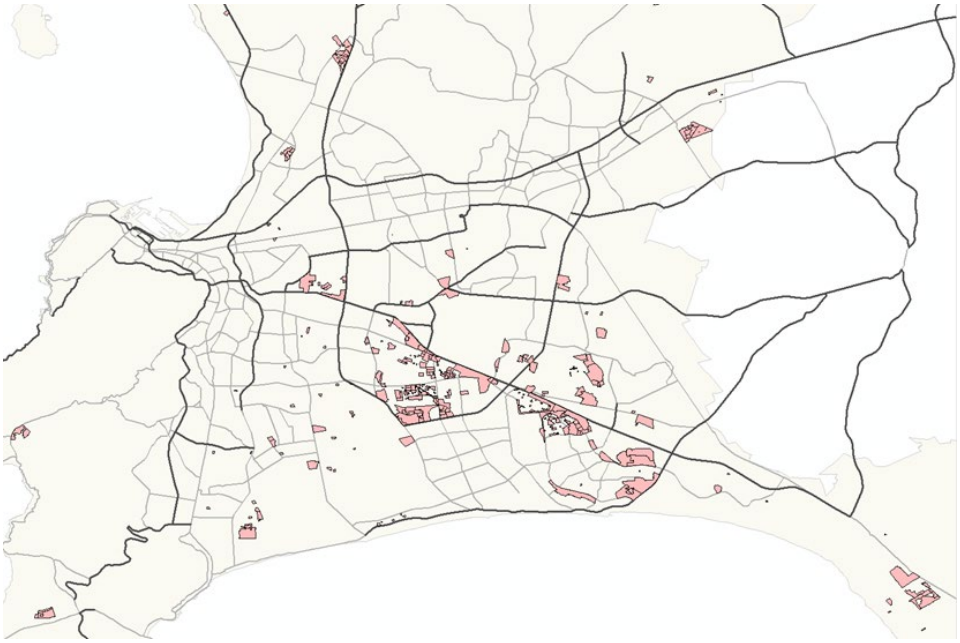


Figure 9: Location of informal settlements in Cape Town

3.2.2 Murder rates

The Cape Town murder rate for 2007-08 was used to aid the identification of potential areas of civil unrest. This layer was created by inserting murder rate data (CoCT, 2009) into a layer for the Cape Town police station boundaries[3] (OpenUp, 2014). While this data is over 10 years old more recent spatial data from www.crimestatssa.com and from CrimeHub[4] drawing from the South African Police crime statistics (2018) support the broad pattern of civil unrest seen in the spatial distribution in Figure 10 below. In addition, the State of Urban Safety in South African Cities report[5] (2017) also supports the broad pattern of civil unrest. According to the report, Cape Town has double the murder rate of the other South African cities which is largely attributed to a rise in drug-related crime and increased access to alcohol, drugs, and guns.

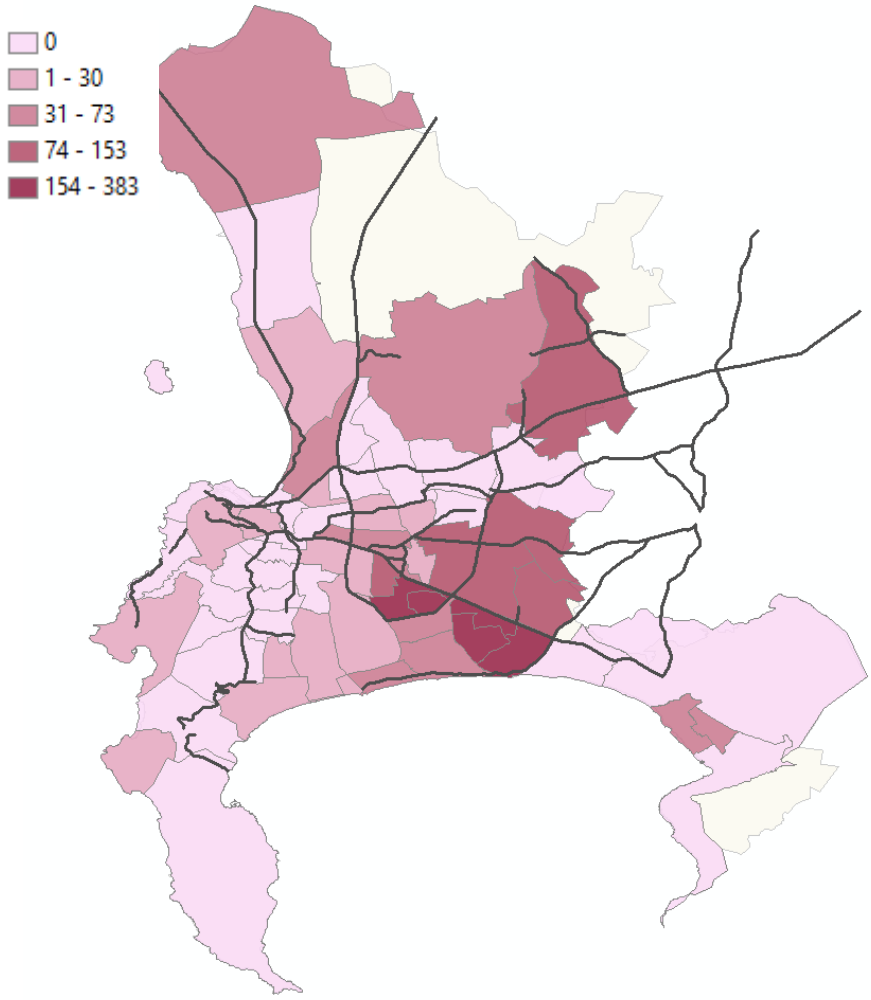


Figure 10: Cape Town murder rate by police boundary 2007/8

[3] Note: police station boundaries do not match up with the exact City of Cape Town boundary hence there are some minor discrepancies around edges of the map.
[4] https://issafrica.org/crimehub/maps/public-violence
[5] http://www.sacities.net/wp-content/uploads/2017/08/The-State_of_Urban_Safety_in_SA_Cities_2017_Report_WEB.pdf

3.2.3 Employment and population

Both employment and population layers come from the same 2011 census dataset (openAFRICA, 2011). The same source provides unemployment ratios of 0.18, or 18%.

The population data shown in Figure 11 below does not factor in area and as such, is not a reflection of population density.

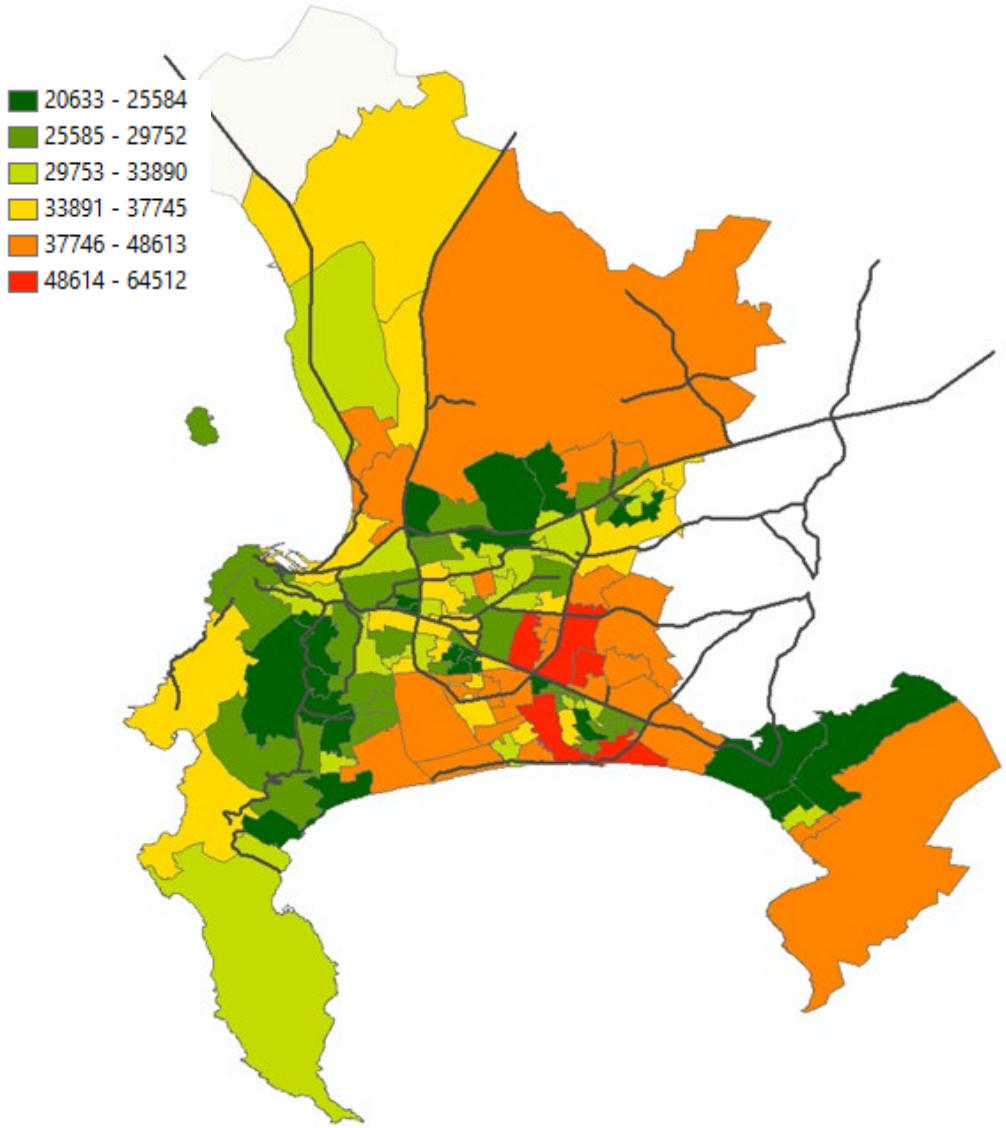


Figure 11: Cape Town population by city ward

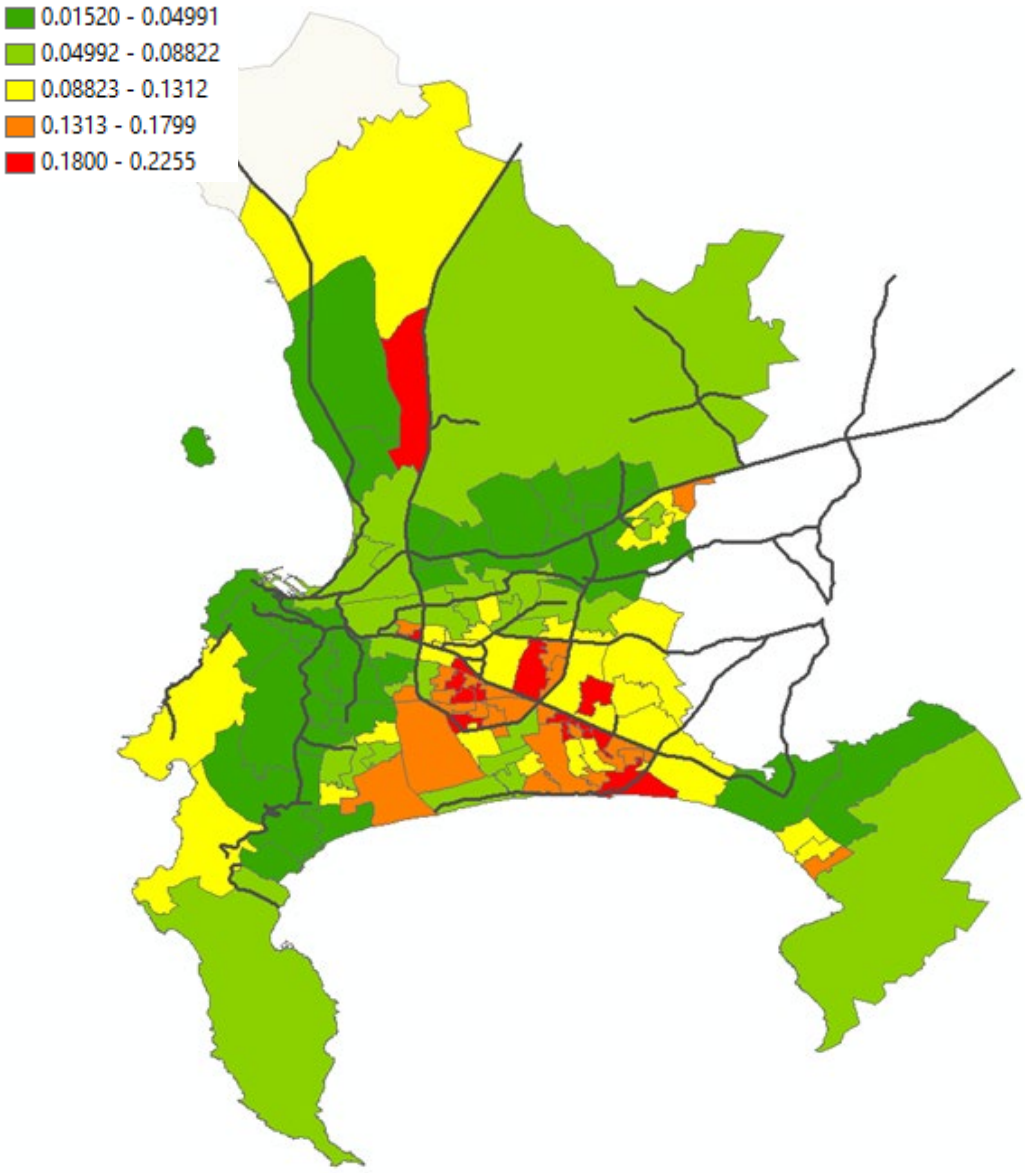


Figure 12: Cape Town unemployment ratios by city ward

3.3 Food network infrastructure

3.3.1 Retail distribution centres and wholesalers

The location coordinates of Cape Town's distribution centres and wholesalers were taken from Google Maps and imported into ArcMap. Although this is a non-exclusive list, it includes the most significant distribution centres and therefore provides a strong indication of the clustering of distribution nodes and wholesalers. A small number of suppliers and exporters were included within this layer; these premises will hold food that could ultimately be requisitioned or diverted in an emergency.

- Site locations: latitude and longitude
- Categories:
    - distribution centre
    - wholesaler – all foods
    - wholesaler – grocer/produce
    - wholesaler – sea food
    - wholesaler – meat
    - suppliers/exporter – food products
    - Supplier – restaurants/hotels
- Sizes:
    - very small (>1,000m^2)
    - small (1,001 – 5,000 m^2)
    - medium (5,001 – 10,000 m^2)
    - large (10,001 – 20,000 m^2)
    - very large (20,001 – 45,000 m^2)

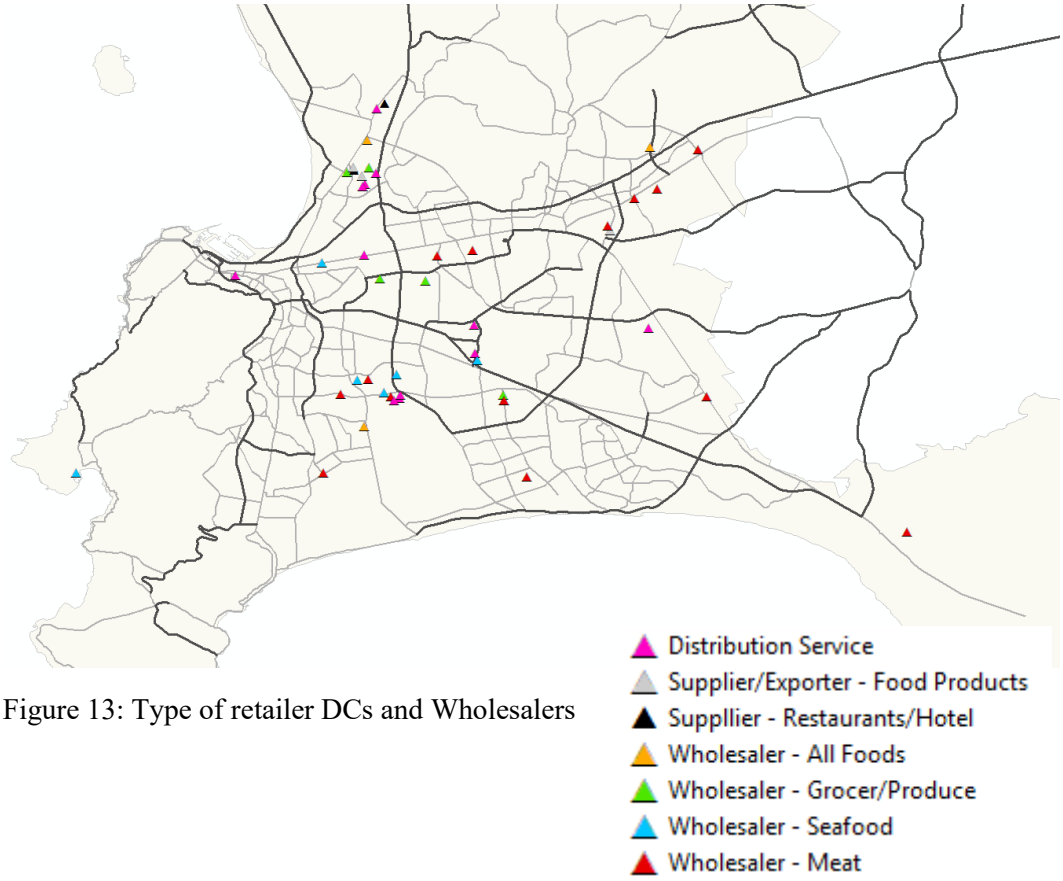


Figure 13: Type of retailer DCs and Wholesalers

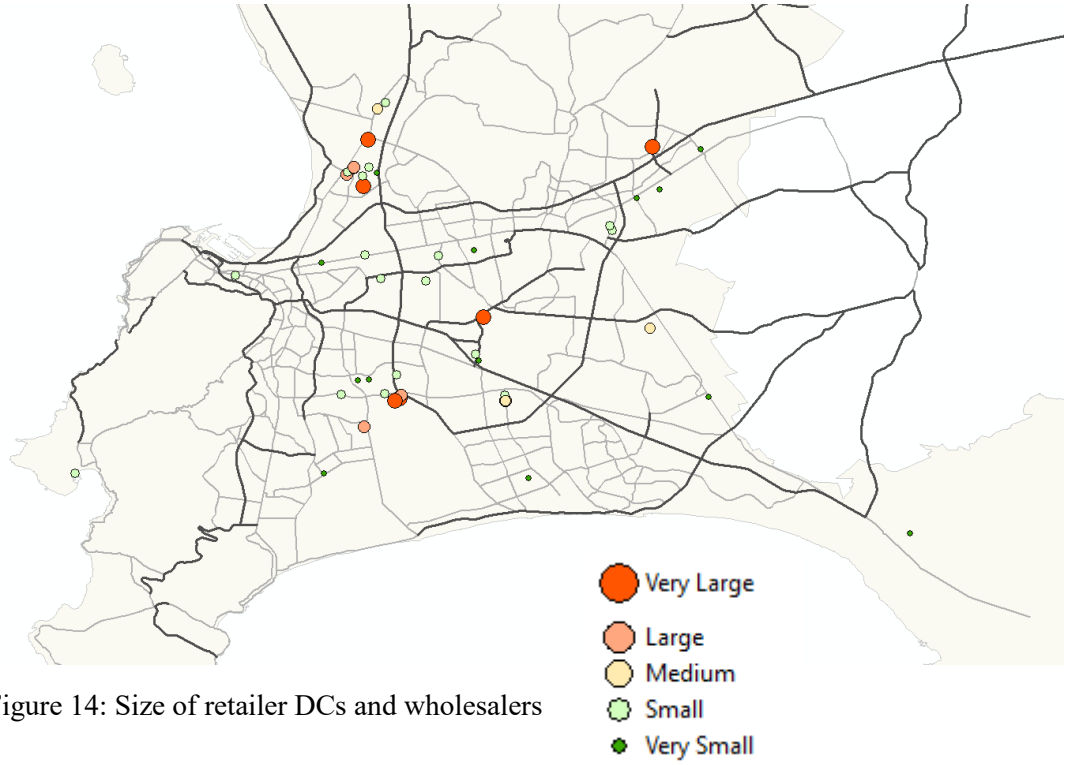


Figure 14: Size of retailer DCs and wholesalers

3.3.2 Fresh produce market

The location coordinates of the Cape Town Market were taken from Google Maps and imported into ArcMap.

Figure 15: Cape Town fresh produce market

Initially other much smaller "lifestyle" markets (for example: Neighbourhoods Market and Earth Fair Market) were included in the analysis. However, "lifestyle" markets were removed from the analysis as their overall volumes of transactions are low[6]. The Philippi Fresh Produce Market has also been excluded as it has largely ceased to function as a produce market.

We have retained the Fresh Produce Market as a separate entity due to its size, significance, impact on the scenario analysis, and the unique position it plays as a privately-run market with oversight and governance provided by the city.

[6] While "lifestyle" markets are important in terms of the social value they bring, economic activity they generate for the surrounding shops, the education/environmental message they stand for, and the public spaces they activate reducing crime ratios, these "lifestyle" markets have not been considered in the scenario analysis because they do not have a significant impact on the overall resilience of the food system

3.3.3 Food processors

The most recent data on food processors available to the research team originates from the City of Cape Town in 2013. Environmental Health holds data on food producers within the city through their registration of Certificates of Acceptability. The City provided a list of 616 food processors in the city licensed to sell to retailers. There are also of the order of 10,000 retailers and restaurants licensed to sell food throughout the city. Of the 616 processors identified, 584 had verifiable address details located within the city boundaries.

The data shows food processors by location and the following categories: milling, beverages, catering, baby food, confectionary/cookies/chips, diary, fish/seafood, fresh produce, frozen food, general, ice cream, meat/biltong, nuts/dried fruit, oil, pies, condiments etc.

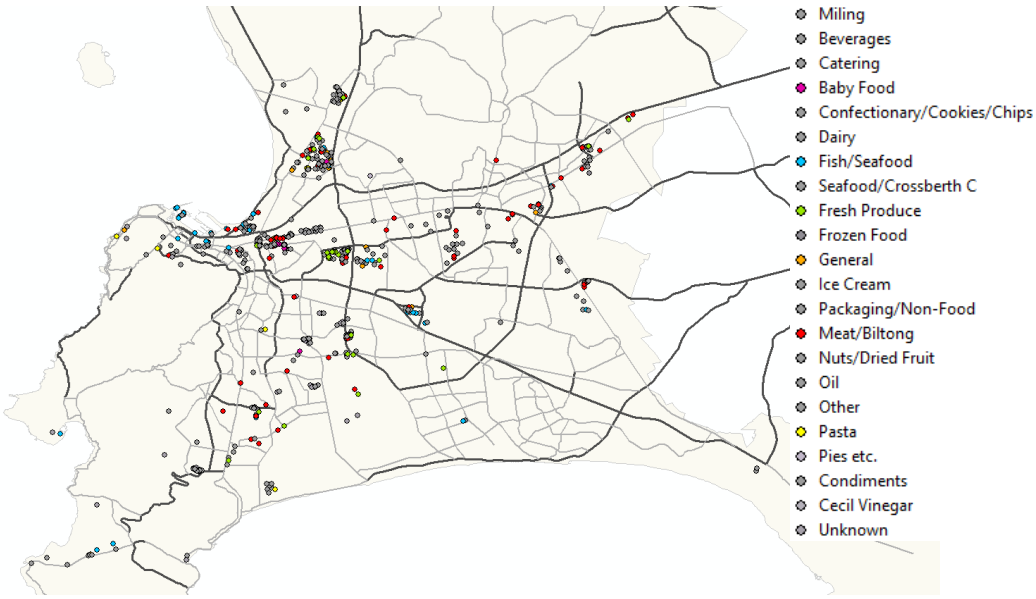


Figure 16: Food processors as recorded by CoCT Environmental Health – Certificates of Acceptability (2013)

3.3.4 Formal retailers

Data on formal retailers (supermarkets) was received from the ACC. The main supermarkets in the Western Cape are Pick N Pay, Spar, Woolworths and Shoprite comprise 97% of food retailing in the CoCT, and 60-70% of the provision of food direct to the consumers. The remainder is provided by informal food supply.

There are 355 supermarkets that have been mapped by location and with the following names:

- Shoprite/Checkers/Usave
- Game Outlets
- Pick n Pay
- Fruit and Veg
- Spar/Superspar/Kwikspar
- Woolworths

Figure 17: Formal food retail in Cape Town is dominated by 4 supermarket chains

3.3.5 Informal retailers

It is not possible within this research to identify and locate all informal retail outlets within Cape Town. The ACC supplied GPS locations for the informal retail units within the Khayelitsha (Ward 95) and Philippi (Ward 34) areas as of August 2013 which was gathered as part of specific research into informal retailers. This data represents the broadest spatially referenced data available on the locations of informal retail outlets in Cape Town. More recent work has been carried out by the Sustainable Livelihoods Foundation[7] within specific sites that reinforces the spatial patterns of informal retailer distribution (February, 2019).

[7] http://foodsecurity.ac.za/wp-content/uploads/2019/02/FINAL_CoE-RR-002_SLF-Feb-2019.pdf

Khayelitsha and Philippi

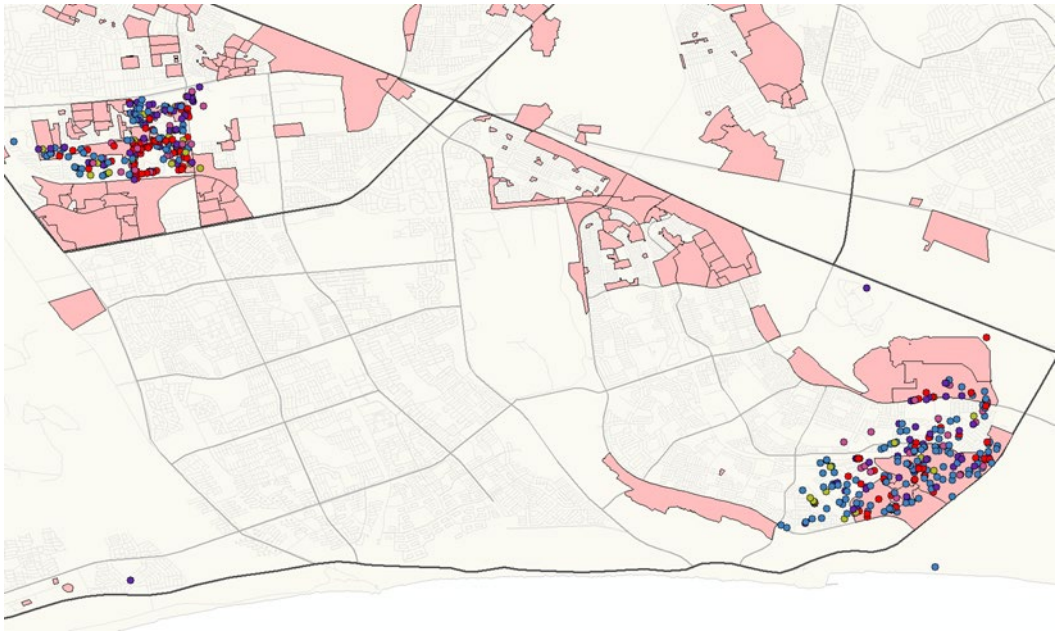


Figure 18: Informal food retailers in Khayelitsha and Philippi wards demonstrating the density of retailers within informal settlements

Philippi ward

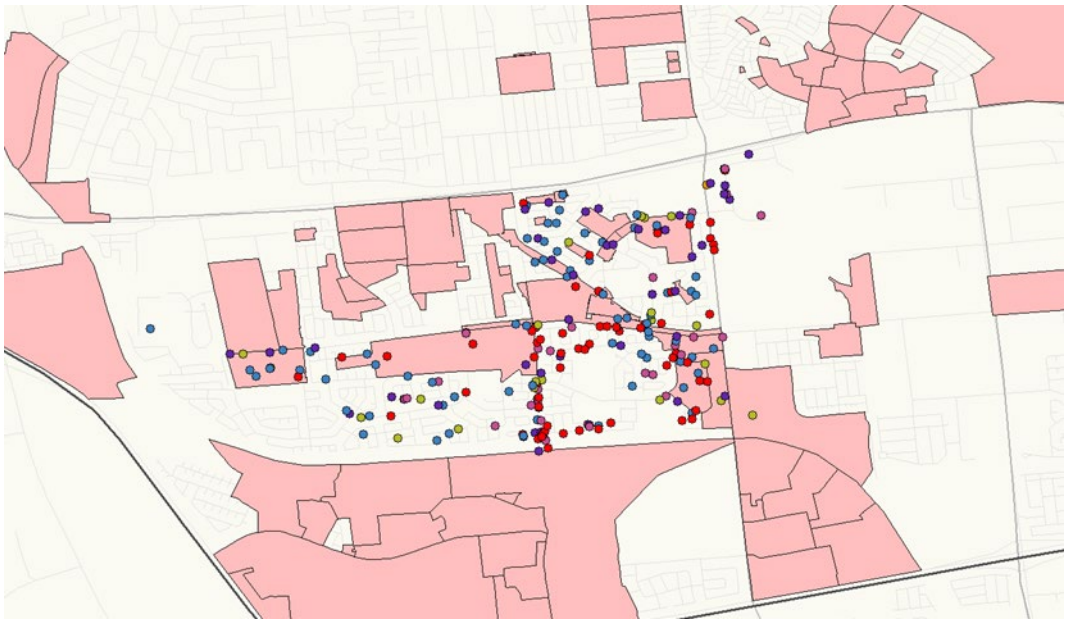


Figure 19: Formal retailers, two informal retail clusters and informal settlements

From data available for Khayelitsha and Philippi wards it appears that the clusters of informal retailers largely correspond with the locations of informal settlements. Although some of the informal retailers are in formal areas adjacent to the informal areas. This relationship pattern appears to reflect the principle customer base of informal food retailers which are residents of informal settlements.

It is therefore assumed that most informal retailers in Cape Town will also be positioned in, or close to, informal settlements in the analysis of the scenarios. In addition, some informal retailers will be located near stations, bus stops and formal retailers on routes to and from these informal residential areas.

Google maps image of Philippi ward

3.4 Flood Data

Flood data used in the scenario analysis comes from the South African National Space Agency (SANSA) data, using the worst case of data available of flooding up to 5m above the mean water level. This impact is shown in blue below along with the primary and secondary road network.

Figure 20: Flooding - 5m level

Finer resolution flooding data does exist at a neighbourhood scale for the Cape Flats area only. The level of detail available from SANSA is sufficient for the purposes of this study.

Note: there is additional flooding within the City of Cape Town boundary (further north) which is not shown as it does not overlap with any of the other datasets available, such as processors and wholesalers.

3.5 Scenario assessment assumptions

The following list of assumptions have been referred to when constructing the scenarios:

- Systems-based scenario analysis is typically carried out through a consultative process with multiple stakeholders and experts across all sectors within a city to help draw together complex inter-system relationships. Due to time and other constraints this was not possible and our research team included a Capetonian food expert to act as a proxy for wider stakeholder consultations.
- Food distribution is practically and entirely dependent upon the road network. There is no significant movement of food into or around Cape Town by rail or air.
- Food import through the airport is insignificant due to the cost of such food imports this is assumed to supply an insignificant proportion of the population.
- Food import/export through the port is significant, however it was not possible within the timeframe of the study to determine how much of the food imports through the port remained within the City. According to a Wesgro report, in 2017 the Western Cape exported around 50% of all South African global exports of prepared foodstuffs, fruit and vegetables[8].
- Fishing does account for a small but significant volume of food and access to the port (and other fishing landing areas) around Cape Town will have an impact on fish supply. The impact is likely only to be experienced within the short-term flood scenario and is unlikely to be impacted by any of the other scenarios under investigation. Due to the low impact, it is a level of detail we have excluded.
- Between 2015/16 and 2016/17 passenger numbers on Cape Town's Metrorail reduced by 30% (2.7 million journeys), with approximately half of all commuter journeys being carried by rail and the other half by road.
- Of the scenarios we have explored in this research we have only considered relative short-term interruptions to supply overall due to shock scenarios.
- Environmental data such as degradation of the natural environment or the urban spatial environment around the food retailers/markets/processing areas has not been considered as part of the scenario assessment. Equally, information on health such as nutrition levels and obesity rates have not been included.

[8] http://www.wesgro.co.za/pdf_repository/The%20Western%20Cape%20-%20Africa%E2%80%99s%20Trade%20and%20Investment%20Springboard%20(2017).pdf

4 Scenario descriptions

This section provides a description of each Scenario. The information presented in Section 3 above is interpreted in the ways described below against each scenario. Section 5 presents the analysis, results and recommendations of each scenario.

Scenario 1 - Whole system flooding

This scenario assesses the impact of flooding in Cape Town on the food system, which will potentially impair the system's ability to hold and move stock and on the population's ability to access it. The worst-case flood scenario - the 5m flood level data – has been used in the scenario analysis.

Historical data has been utilised from SANSA (South African National Space Agency) that identifies specific areas of the city where flooding has been prevalent and assesses the impact future floods could have on the operation of the food system, particularly on the ability to produce foodstuffs or receive it through local distribution centres or from elsewhere in South Africa.

The impact of flooding has been considered in terms of:

- Direct impact to specific components of the food system, such as processors, distributors, and formal / informal retailers.
- Direct impact to transport infrastructure, specifically road and rail infrastructure.
- Direct impact on residential areas (formal and informal).
- Accessibility to nearby sources of food retail for the residents of Cape Town.
- How it impacts residents living in informal settlements, which also happen to be the highest flood risk areas in the city.

In addition, we have considered that the flooding does not happen in isolation and is usually associated with winter storms. These storms usually have the following additional impacts:

- Structural damage to infrastructure providing power, especially as informal settlements may have a higher proportion of unregistered power connections.
- Structural damage to residences in flood areas, particularly in informal settlements as they often employ rudimentary construction methods and are on flood plains.
- The impact on informal retailers who are mostly congregated within informal settlements.

Scenario 2 - Civil unrest

This scenario assesses the impact of civil unrest in agreed areas in Cape Town against the city's ability to store and transport goods. Again, historical data has been used to identify where the likely areas of civil unrest are likely to occur.

The research has looked at two sub-scenarios namely: -

1. The largest congregations and concentrations of informal settlements, which are along the National Route 2. This also equates with the areas of highest crime as deduced from the murder rate by police station areas.
2. An extension of the above to all the areas with informal settlements in the Cape Town area.

Civil unrest has been primarily considered in terms of:

- Fires being set in uncollected waste within informal settlements to highlight the lack of facilities, utilities and waste collection in these areas.
- Fires being set on primary and secondary road routes (burning tyres), as a protest to highlight the sort of protects above.
- Xenophobic violence within the informal settlements. It is expected that this will lead to the looting and the short to medium term removal of a very significant number of the informal retailers in the affected areas. Most Spaza owners are foreign, but the fruit and vegetable traders are largely local and may escape this process.
- All or some of the above being created by political agitators in an organised manner who will ensure that all areas with informal settlements are included and the time taken to clear is extended.

Scenario 3 - Transport resilience

The final scenario looks at the resilience of the transport network including roads, railways, the port and airport as shown. There will be one scenario that assumes that the rail system is not operational. The road system will therefore need to be able to provide an alternative means of transportation in Cape Town.

This scenario primarily considers:

- All the passenger journeys that are currently carried out daily on the rail system being moved to the road.

5 Scenario analysis

This section presents the analysis of each scenario, including the impact and possible actions for each. The analysis is developed based on desk-based interpretation and interpreted with a local food systems expert.

We have tagged each recommendation with one of more of the following categories:

Category	Description	Ease / Time (for implementation)
Planning	Activities that can be done in advance to reduce the impact or speed the recovery of food distribution for each the scenarios identified.	An estimation of the level of ease (simplicity of task) • Easy • Difficult And the likelihood of it being done quickly or taking a lot of time to produce. • Short Term • Medium Term • Longer Term The above takes no account of cost or political feasibility
Preparation	Activities to reduce the impact on the food system of the scenarios when they occur, done prior to the scenarios occurring.	
Forecasting	Activities that predict the likelihood of the identified scenarios occurring in the near term, so measures can be put in place or practiced prior to the scenario occurring.	
Coping	Activities to reduce the impact on the food system of the scenarios when they occur, done when the scenarios occur.	
Recovery	Activities to speed to recovery of the food system after the scenarios have concluded.	
Even Longer Term	Recommendations that are very long term social and economic measures that will reduce the likelihood of the scenarios occurring. These are only identified in the conclusion as they are considered at the very edge of the scope of this piece of work.	

In the final sections of the report a less annotated description of the recommendation is used as they are pulled together from the three scenarios and when seen overall, more general ones are added.

5.1 Scenario 1 - Whole system flooding

The impact of flooding on the different elements of the food system in Cape Town is described in more detail below and summarised in the following bar charts.

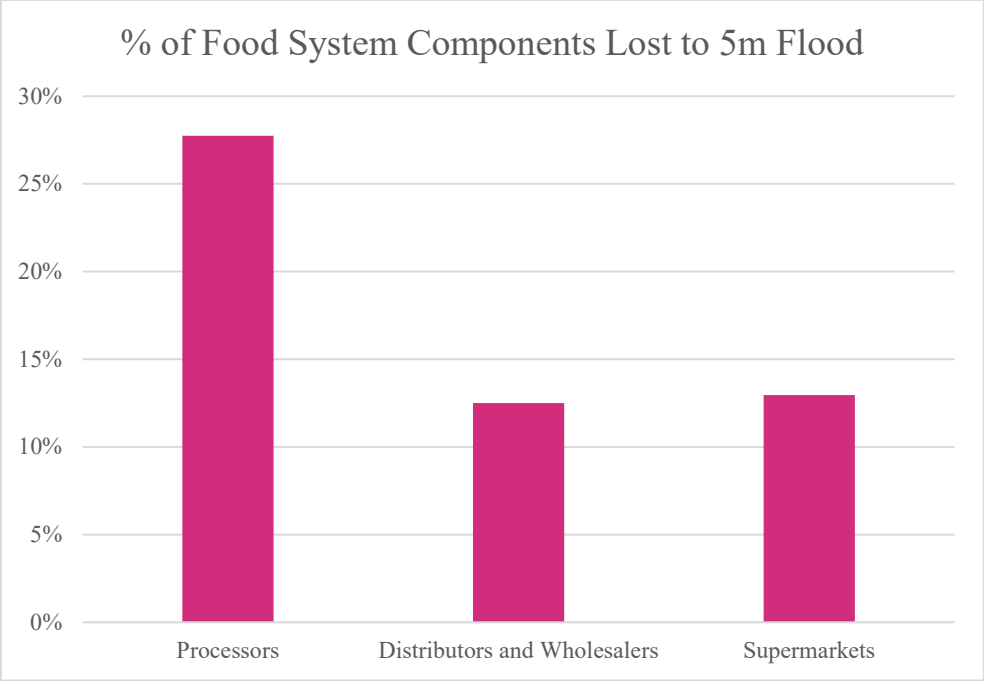


Figure 21: Food system components lost in a 5m flood

Food System Component	Total	No Lost	% Lost	Comments
Processors	584	162	28%	
Distributors and Wholesalers	48	6	13%	
Fresh Produce Markets	1	1	0%	Close to flood line
Super Markets	355	46	13%	

Included in the 13% of distribution and wholesalers are several near misses to the 5m flood. This is seen in the breakdown into two categories of near misses ("close" and "vulnerable") given below. The table below provides an estimated m^2 floor space impacted within the buildings concerned.

Distributors and Wholesalers	Total m^2	m^2 lost	% of m^2	Comments
Flooded	331300	23700	7%	One major RDS flooded
Close (immediate edge)	331300	7950	2%	
Vulnerable (within 1km)	331300	9100	3%	Major cluster just outside of 1km
Total		**40750**	**12%**	

We have excluded from the Vulnerable data the Fresh Produce Market in Epping as it is discussed here as a separate item (and this is part of the reason for keeping it as a separate item as it is singular and large). In this case the flood line comes within approximately 500m of the market.

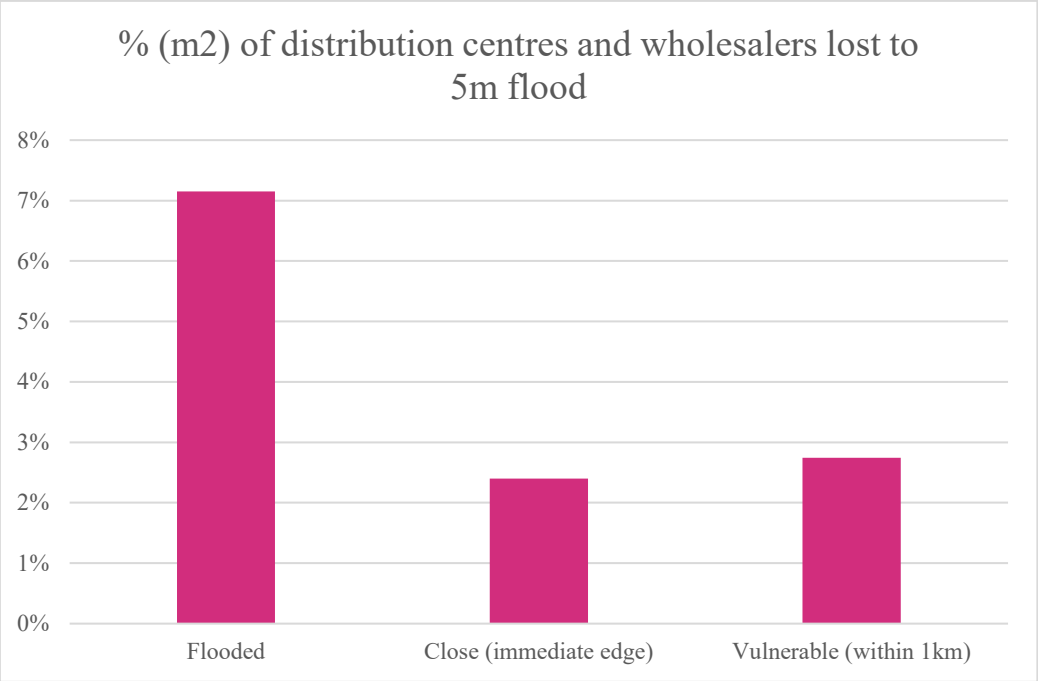


Figure 22: Percentage of floorspace (m^2) of distributers and wholesalers lost to flood

During the flooding scenario, the transport network is likely to be impacted mostly through the loss of rail (18%) followed by primary roads (13%). The impact on the transport network will make it difficult to resume operations.

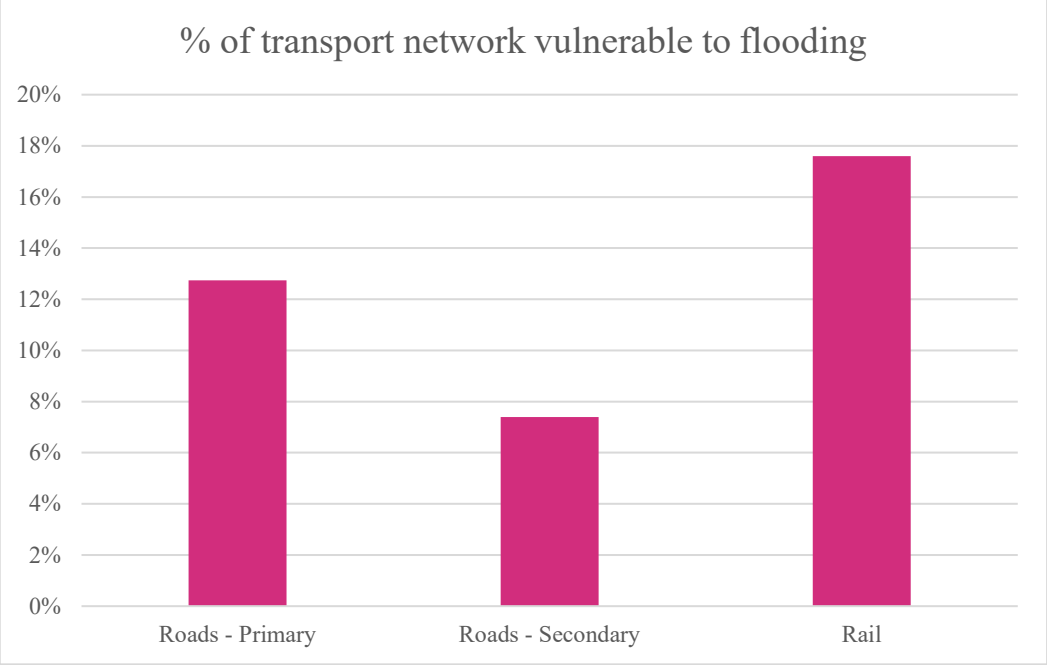


Figure 23: Loss of roads, and rail in the flooding scenario

Transport Network Component	Total	% lost	km lost	Comments
Roads - Primary	500	13%	64	
Roads - Secondary	930	7%	69	
Rail	679	18%	119	

The rail loss may mean the overall rail network is largely unusable as it appears to encompass the specific locations of major spurs within the cities rail network. Further investigation is needed to understand the specific impacts likely when these specific rail locations are inundated.

5.1.1 Impact on processors

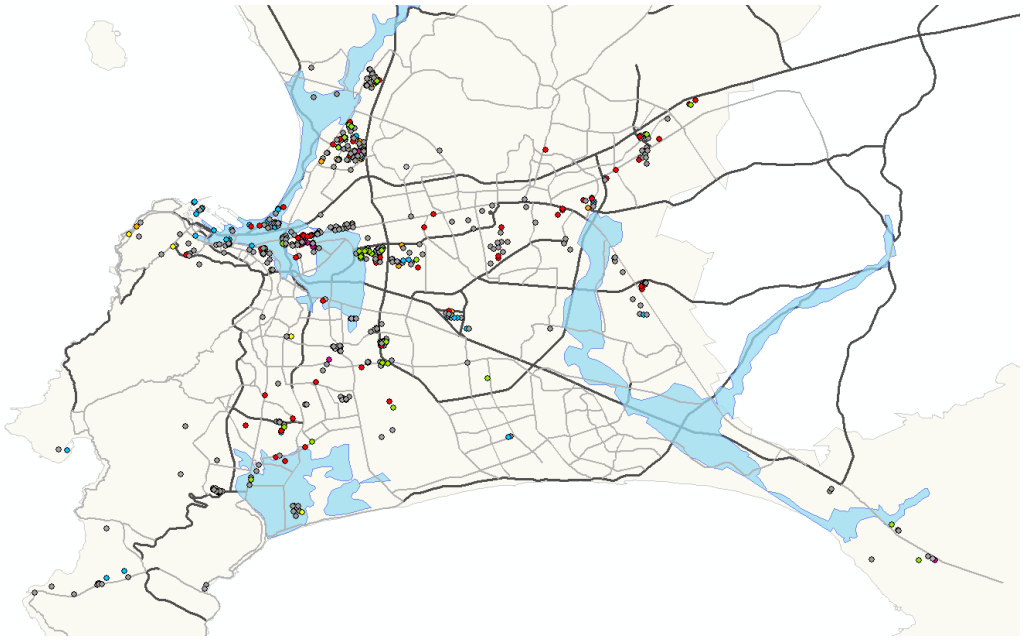


Figure 24: Flood levels, food processors and informal settlements

Of all the elements of the food system looked at, the food processors are the most impacted by flooding. Of the 616 food processors registered with the City of Cape Town, approximately 25% of food processors are projected to be impacted by the whole system flooding scenario.

5.1.2 Impact on distribution centres and wholesalers

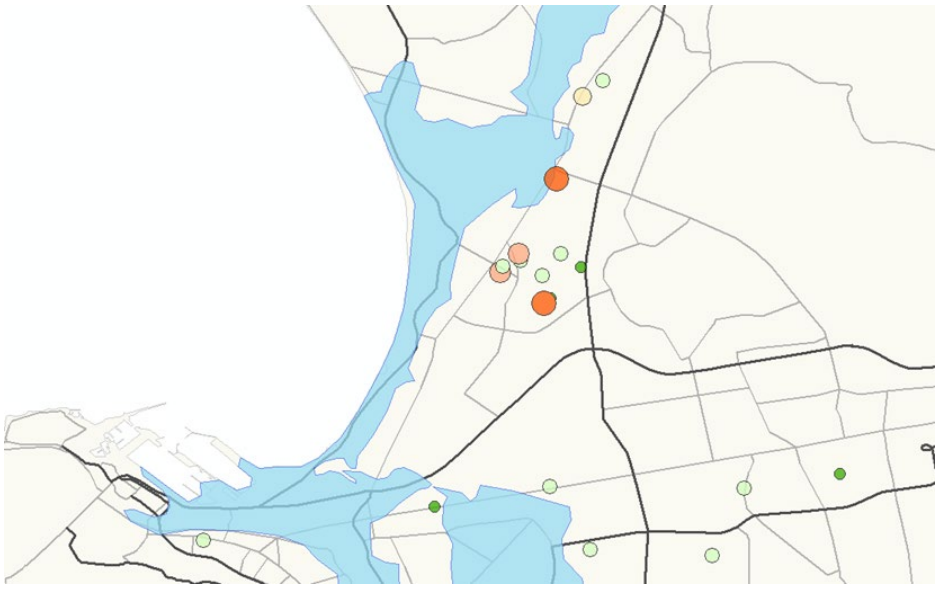


Figure 25: Flood levels, DC and WS

Distribution centres and wholesalers are generally not impacted by the flooding scenario but a cluster around Milnerton that includes a very large DC is vulnerable. Flood mitigation measures and defences may already in place - this is beyond the scope of this study.

5.1.3 Impact on fresh produce market

Figure 26: Flood levels, fresh produce impact - close up

The Cape Town Market is within 500m of 5m flood line (see above). This ~80,000m^2 (nearly twice the size of the largest regional distribution centre). Given the city's dependency on this location, it represents a key area of vulnerability in

the event of a large-scale flood. Road access is also likely to be reduced or compromised.

5.1.4 Impact on formal retailers / supermarkets

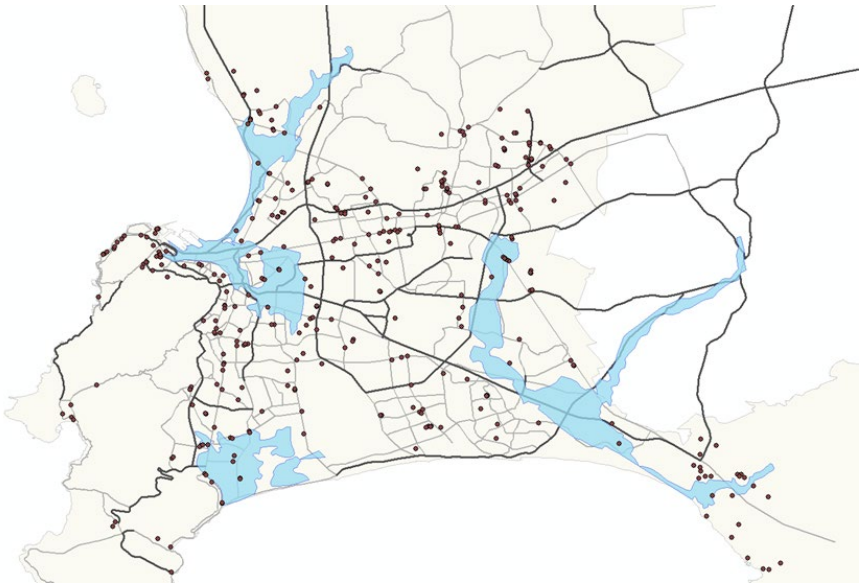


Figure 27: Supermarket location and flooding

Formal retailers in the form of supermarkets are not significantly impacted by the expected levels of flooding, even at the 5m mark. For those in the flooded areas it is assumed that insurance and normal corporate processes will deal with the re-establishment of those stores in the same or similar locations based on risk analysis done by the owning corporations.

5.1.5 Impact on informal retailers

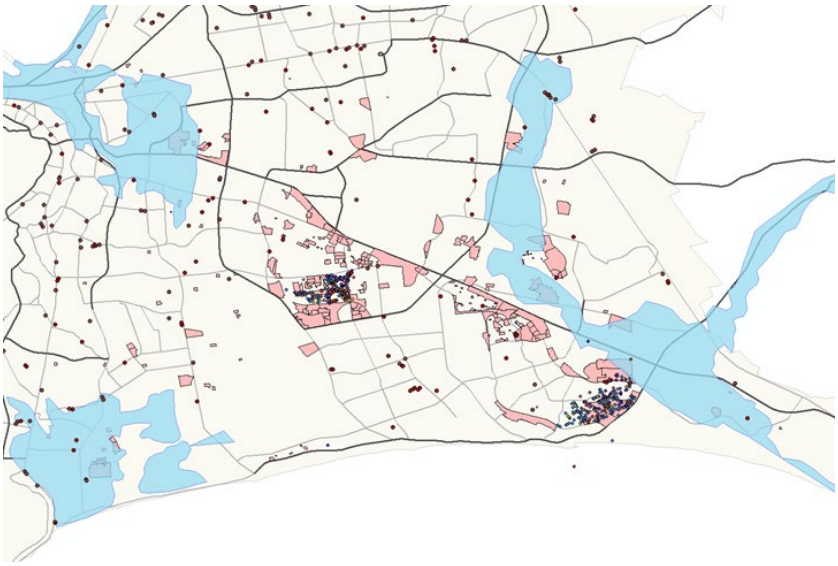


Figure 28: Informal settlements and retailers, and formal retailers

There are several informal settlements that are completely covered by the flood water. This will create a situation of short term displacement of populations with no access to their typical informal retailers along with impacts on local economy and livelihoods.

In addition, some informal settlements that are not flooded will be also have their links between the informal retailers and the supplying wholesalers, markets, abattoirs and producers temporarily cut or significantly lengthened.

There is additional localised flooding that is common in many areas of the Cape Flats and while data for this specific area does exist this research looks at the city as a whole and therefore uses the SANSA 5m model[9].

[9] Thesis by Rose Mutaleni available to demonstrate the micro-scale flooding in the Cape Flats - https://open.uct.ac.za/handle/11427/22942

5.1.6 Impact on the road network

Figure 29: Floods and the road network

In the data it has been assumed that any roads within the flood areas will be impassable. This is likely to be an exaggeration for the primary roads as they are by and large drained and on causeways, so we have a worst-case scenario.

In most cases there are alternative routes between the elements of the food system that are still functional. Thus, we would expect an increase in journey time and congestion on the remaining open routes.

Some of the routes that will be impacted are city centre routes, near food markets, and involve underpasses and other low-lying roads.

5.1.7 Impact on the rail network

Figure 30: Flood and rail overlap

From the data available it would seem likely that the rail network will be significantly impacted by a flood as one area most likely to flood includes the approaches to the Central Business District (CBD) as well as appearing to break the network in several places.

As indicated in the similar discussion on roads, some or all of this rail network may be on raised causeways and elevated sections, which will limit some of the expected impact.

The impact of the rail network not being available or significantly impaired could be considerable on the remaining transport network if all commuter journeys normally attempted by rail passengers are transferred to road journeys in minibus taxis, small private buses and the MyCITI bus network adding to issues of congestion.

However, if the impact of the flooding on the centre of the city, train and residential areas led to reduced overall commuter activity for the duration of the flooding, as the CBD is flooded, this could be reduced and may even lead to a less congested road network for the vehicles that have to travel, such as retailer, wholesaler and producer/processor trucks.

See Figure 31 – Cape Town's city rail network for compassion with the flood impact on rail (Figure 30) above.

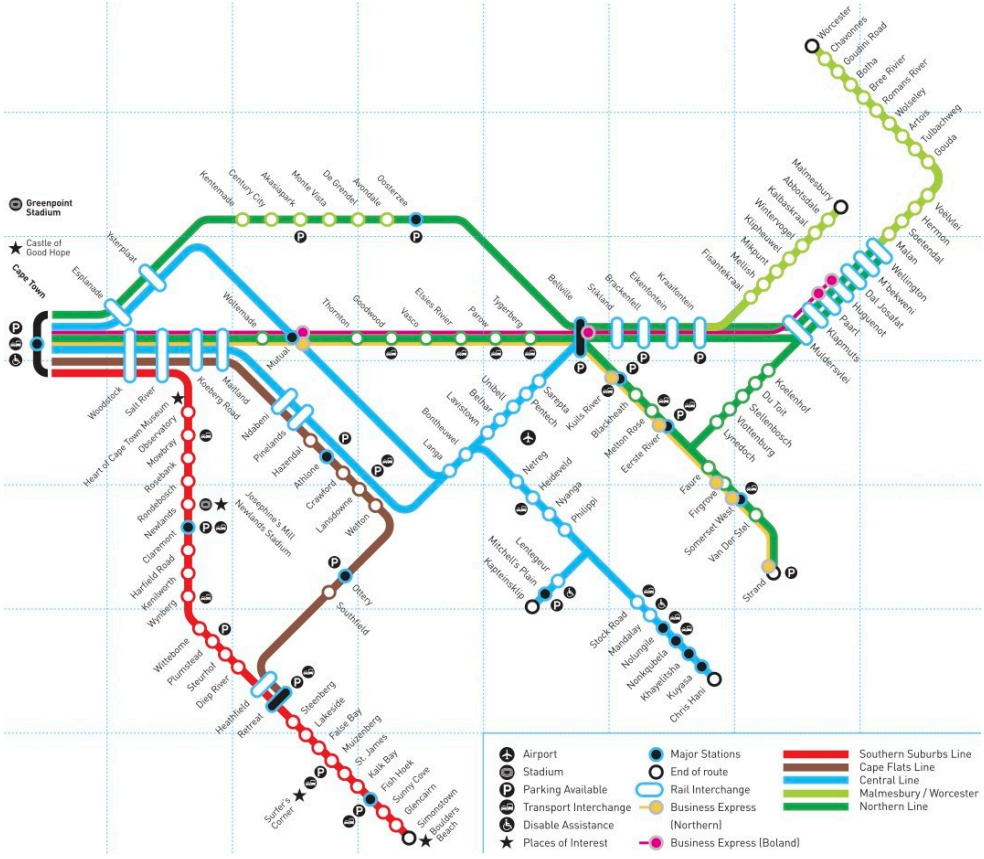


Figure 31: Cape Town city rail network

5.1.8 Summary of impacts

- Whole system flooding will have a large impact on the food system making physical access to affordable food more difficult due to reduced supply and reduced access routes to food retail. Flooding would also interfere with the food supply chain, such as production, processing, and distribution within the city.
- Flooding would result is a loss of about a quarter of food processors during the flood event itself, plus the additional time required to get them back up and running after the flood subsides.
- There is less concern over the moderate loss of formal retailers, distribution centres and wholesalers.
- The loss of stock for small informal retailers is a significant challenge given their limited capital to replace damaged stock and their ability to remain viable through prolonged shutdown.
- The impact that a flood scenario can have on the local economy, employment and the livelihoods, particularly of vulnerable people, should be investigated further.
- A small number of roads will be impassable by flooding, with (for the food network) alternative routes available for almost all required paths.

- Either/or: -
    - Minor congestion and longer journey times on the road network due to less overall traffic as commuters will not be attempting to go to work vs. vehicles that are moving using fewer roads to avoid floods.
    - Major congestion as the rail network is essentially closed and the majority of rail commuter journeys are displaced to the road network. Large impact during the replenishment of the food network – which may increase congestion further as delivery schedules unravel and more vehicles are required to deliver the same volume of stock to the same or reduced number of delivery points.
- Possible impact on refrigerated food in homes and informal retailers from electricity failure.
- Fatalities from illegal connections to the electricity infrastructure failing in wind, rain and with saturated ground.
- Loss of shelter, especially in the informal settlements, and loss of existing stocks of food in those areas. Additionally, deferral of money that would have been used to purchase food to post shock household recovery will impact upon food security.
- Loss of food stock in the informal retailers situated in the informal settlements and other areas that flood. Reduction in the total number of retailers available to the informal settlements.

5.1.9 Coping strategies

It is expected that the following changes in behaviour are likely to occur following a flood scenario:

- Residents of informal settlements will use alternative informal/formal retailers in the same or nearby settlements. Use of formal retailers is likely to be short term due to cost.
- Suppliers of informal retailers have to use different wholesalers, markets, farms and abattoirs to resupply informal retailers – where the is a lack of established relationships may reduce supply into the affected areas.
- Provision of nutritious but basic food supplies by emergency relief agencies to supplement the remaining food network.
- It is expected that any migration out of informal settlements during a flooding scenario will be temporary.
- Coping strategies need to be identified to build the resilience of the informal retailers to plan for and withstand flood events in their neighbourhoods.

5.1.10 Recommendations

The following table provides recommendations that can be considered by the CoCT resilience team.

Priority	Category	Description	Ease / Time
1	Preparation	**Seasonal work scheduled** and resourced such as clearing storm drains, flood water outflows, storm water inlets, open drains, dredging water course that drain areas prone to flooding. Especially where the work will ensure clear roads. Proactive consideration of the solid waste management to see if there are particular challenges that shape waste behaviour in informal settlements, which then leads to pollution down storm water drains.	Easy Short
2	Forecasting	**Use forecasts and seasonal data** to predict floods and plan key preparatory work (see seasonal work recommendation above) to ensure correct equipment, manpower, skills available, and to prepare signposts and information highlighting alternative routes. Opportunity to invest in a forecasting/data collection/monitoring system that links to a wider digital/smart agenda for the city that would address one of the known challenges in South Africa which is the accuracy of downscaled forecasting i.e. localised forecasting suitable for knowing when to plan seasonal work. **This recommendation links to challenges of downscaled forecasting in South Africa and for Cape Town.*	Difficult Short
3	Preparation Planning	**Identify impacted routes and develop a transport plan** for the most likely flooding scenarios and create pre-planned alternative routes that serve both expected commuting and food network requirements. Include knowledge gained from other retailers such as during **work with retailers and wholesalers.** Include a pragmatic guesstimate of the expected impact on rail and the knock-on impact on congestion.	Easy Short

4	Planning Preparation Coping Recovery	**Work with retailers and wholesalers** to understand the details of their disaster recovery processes and create a combined strategy / logistics plan – such as *identify impacted routes* and *model the impact of flooding.* Look at incentivising behaviours that are mutually rewarding using the forecast data available, such as: - • Increase stock in retailers, distribution centres and wholesalers that are not expected to be impacted prior to expected seasonal floods. • Plan inbound stock movements with retailers during floods – re-routing roads travelled and destinations • Stock movement and retailer manning at night to move replenishment outside of any peak • Identification of other (non-critical) logistics e.g. construction that can be stopped or displaced to nights	Difficult Medium
5	Planning Preparation	**Work with informal retailers** to advise them of the best forecast estimates of flooding and agree strategies for moving their stocks to other areas in advance of any flooding (**Use forecasts and seasonal data**) which have been selected. Working with trader associations and perhaps using key wholesalers (CTFPM, MAKRO) as points of information dissemination. For example, the City hosts an annual informal economy summit. The participants of the most recent summits could form an initial network for this communication. The City Informal Trade Unit should also work with the Resilience Office on a communications strategy, as this would enhance business viability.	Difficult Short
6	Planning Preparation	**Model the impact of flooding** on congestion and average journey times / journey time variability of the expected most expected and most extreme flooding scenarios. Include rail and congestion with the expected displacement if rail is impacted. Modelling potential alleviating strategies, such as: -	Difficult Medium

		• Increasing the already prevalent out of hours food replenishment to include all available night capacity on the road network. • Food / HGV only lanes, possibly the deferral of bus and taxi lanes to accommodate food transit. In addition to the need for some traffic modelling software and expertise, hard data describing movements will be required.	
7	Planning Preparation Coping	Working with city Disaster Management to think about what assets might be supplied to prevent households losing food in flood events for example, heavy duty plastic storage containers. This practical recommendation emerges out of work conducted by the Flooding in Cape Town under Climate Risk project[10] which identifies the loss of food and clothing because of flooding to be a common challenge which hinders post-flooding recovery. Coping strategies need to consider the kind of emergency food provision and coordination with disaster relief NGOs – relationships that are already well established in Cape Town	Easy Short
8	Planning Coping Recovery	**Manage resulting congestion** caused by flooding and possible rail displacement traffic by having in place: - • Revised and additional MyCiti bus routes pre-planned to avoid the routes that are expected to be blocked and with additional capacity through extended running times and additional scheduled manpower. • If rail networks are substantially available, offer lower fares in the period(s) of flooding in order to reduce road congestion. • Other transport methods for the food network, such as pipelines, drone, boat / ferry. Or displacement of other traffic to these or other methods – such as monorail for passenger transport	Difficult Short

[10] http://www.adaptationnetwork.org.za/wp-content/uploads/2013/11/Joubert-2013-Rising-Waters-working-together-on-Cape-Towns-flooding.pdf

9	Planning Coping Recovery	**Improve robustness against flooding** of the food network by identifying targeted infrastructure improvements on roads, rail and flood defences that will alleviate the most impacts of the flooding for the projected available funding. These infrastructure measures can incorporate green infrastructure practices, such as Sustainable Urban Drainage Systems (SuDs) that will help alleviate surface water flooding but also create green spaces in the city. An opportunity exists to develop mandatory guidance that ensures all new developments or open spaces to include appropriate green infrastructure solutions, e.g. water squares. **This recommendation links to Partnering for Climate resilience and (water resilience, sponge city) and Fostering resilient placemaking and mobility (public spaces and maximising the resilience of urban waterways).*	Difficult Longer
10	Forecasting	**Long term forecasting** of the expected changes in flooding based on climate change modelling, to inform. Likely to be partnering with climate change specialists. This can inform and of the planning and preparedness activities in this section. **This recommendation links to challenges of downscaled forecasting in South Africa and for Cape Town.*	Difficult Longer
11	Planning	Partner with "big data" providers such as Google to understand impact of SatNav programs on the flow of traffic in the city and the options available when normal routes are compromised. What will the SatNav engines do as periods of congestion escalate, and can anything be done to improve the way the algorithms work.	Difficult Longer

Figure 32: The MyCiti bus network as referred to in the recommendations above

5.2 Scenario 2 - Civil unrest

Civil unrest has been analysed within two sub-scenarios:

1. Most likely areas (purple zones): This scenario considers the impact in areas most likely to experience spontaneous and limited unrest.
2. Combined area (orange + purple zones): This scenario considers the wide-spread impact of unrest, and assumes all informal settlements, and their adjacent neighbourhoods and roads in the Cape Flats area are made impassable.

5.2.1 Defining the scenario boundary

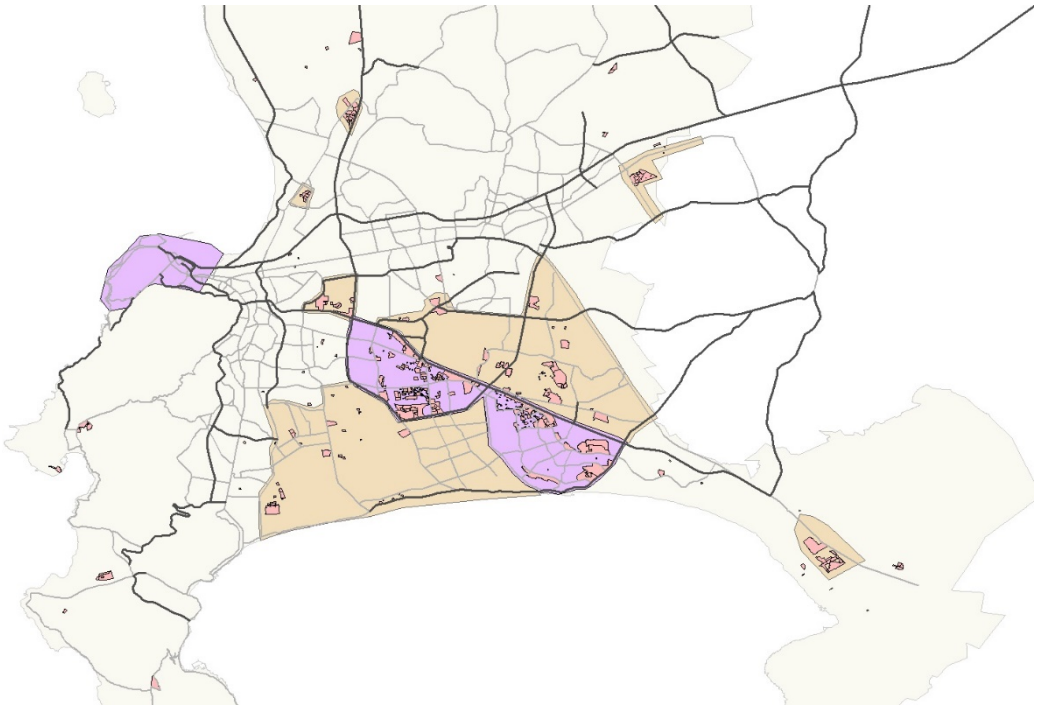


Figure 33: Potential civil unrest areas, road network and areas with highest crime rates

In Figure 33 above, zones highlighted in orange contain informal settlements (pink), demarcated by adjacent or bounding roads. These zones are referred to as **Combined Areas.** Zones highlighted in purple are most likely to be impacted by civil unrest. These are areas with the highest rates of crime and/or potential for protest based on historical data (e.g. ISS Crime Hub). For this analysis, these areas are demarcated using the major roads that run around their edges and considered as **Most Likely Areas.**

A few outlying potential hotspots (e.g. Masiphumelele) have been omitted from the map to focus on hotspots in the Cape Flats area and the CDB.

NOTE: The **combined areas** assumes that all the area around large groups of informal settlements, including the roads, are made impassable. In addition, all network components (processors, distributors and wholesalers, fresh food market and supermarkets) within these areas are made unavailable during periods of unrest.

5.2.2 Results

The impact of civil unrest within the **Most Likely Areas** and **Combined Areas** scenarios can be summarised in the following bar charts and data tables.

Within this data "vulnerable" means vulnerable to being lost.

Most likely areas

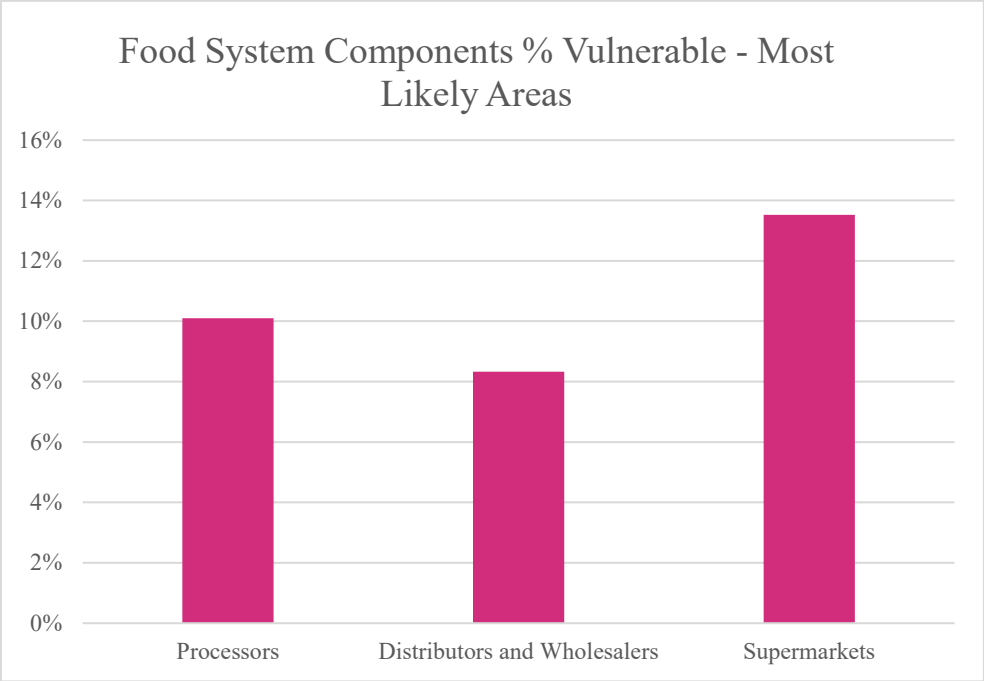


Figure 34: Vulnerable food system components within most likely areas during civil unrest

Food System Component	Total	No. Vulnerable	% Vulnerable
Processors	584	90	10%
Distributors and wholesalers	48	4	8%
Fresh food markets	1	0	0%
Supermarkets	355	76	14%

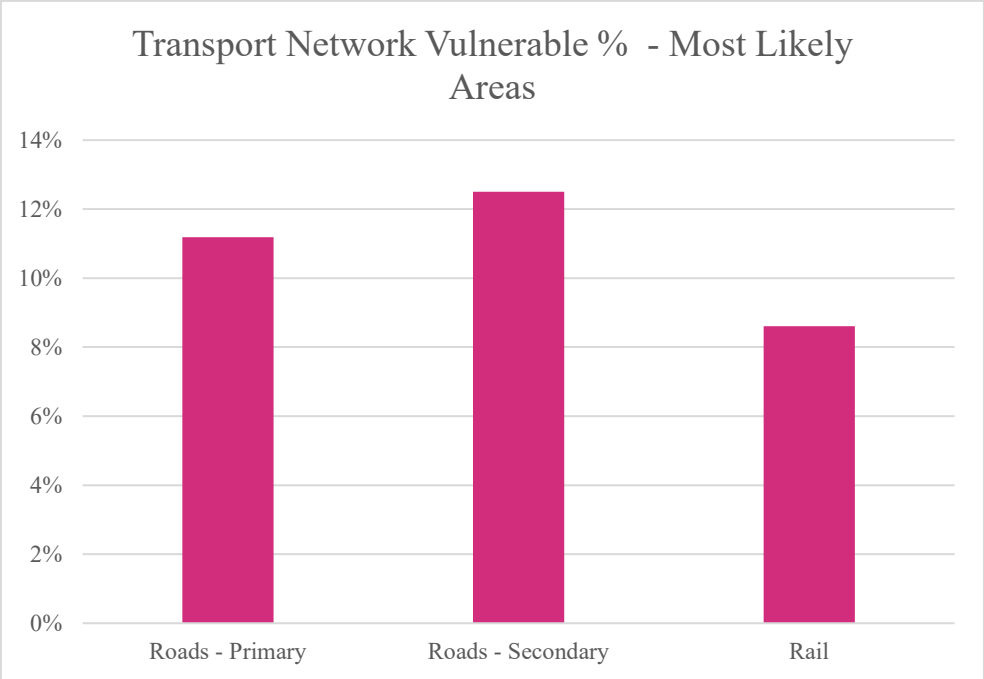


Figure 35: Vulnerable transport network components within most likely areas for civil unrest

Transport Network Component	Total	% Vulnerable	km Vulnerable
Roads - Primary	500	11%	56
Roads - Secondary	930	13%	116
Rail	679	9%	58

Combined unrest areas

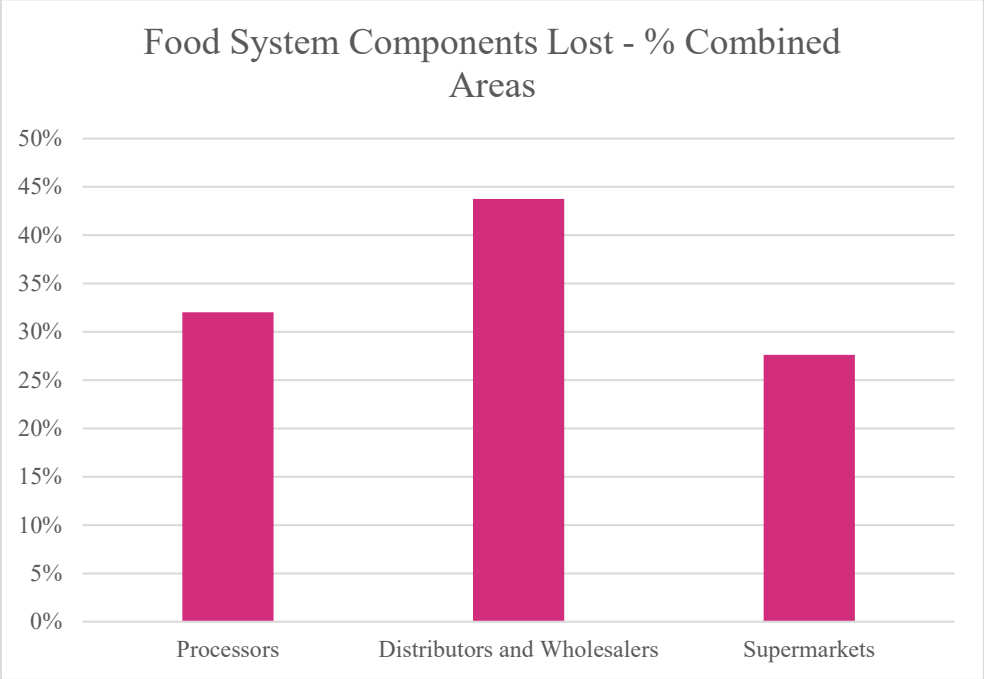


Figure 36: Vulnerable food system components within combined areas during civil unrest

Food System Component	Total	No Vulnerable	% Vulnerable
Processors	584	218	32%
Distributors and Wholesalers	48	21	44%
Fresh food markets	1	1	100%
Supermarkets	355	126	28%

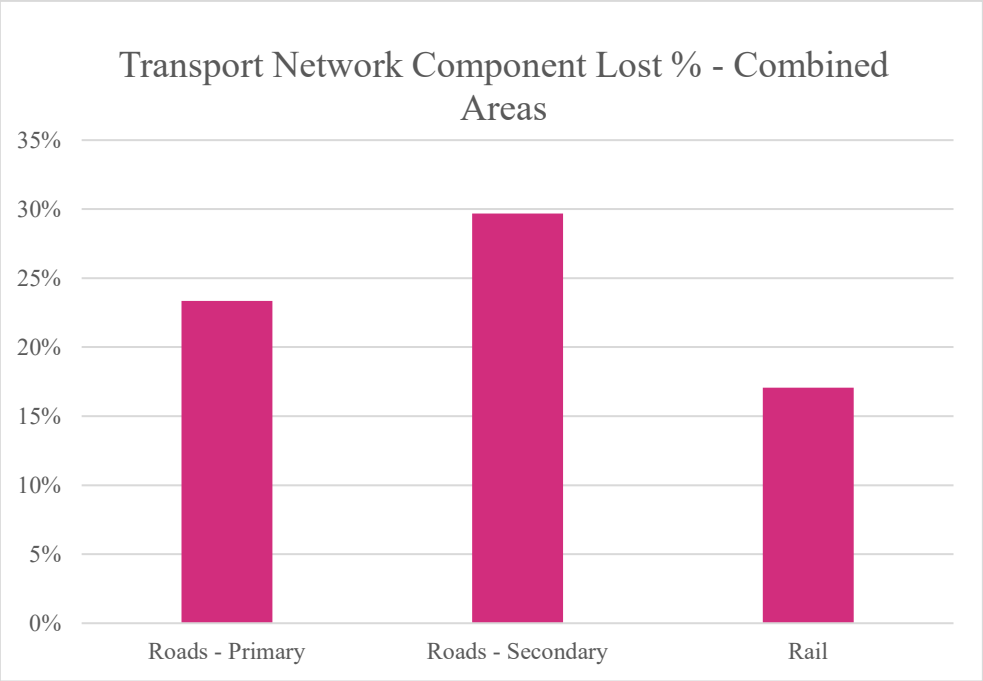


Figure 37: Vulnerable transport network components within combined areas for civil unrest

Transport Network Component	Total km	% Vulnerable	km Vulnerable
Roads - Primary	500	23%	117
Roads - Secondary	930	30%	276
Rail	679	17%	116

The above is an unlikely outcome and it is best to consider this as an absolute maximum upper bound. The following descriptions of the impact on various components of the food system and transport system provide further detail on these results.

5.2.3 Impact on distribution centres and wholesalers

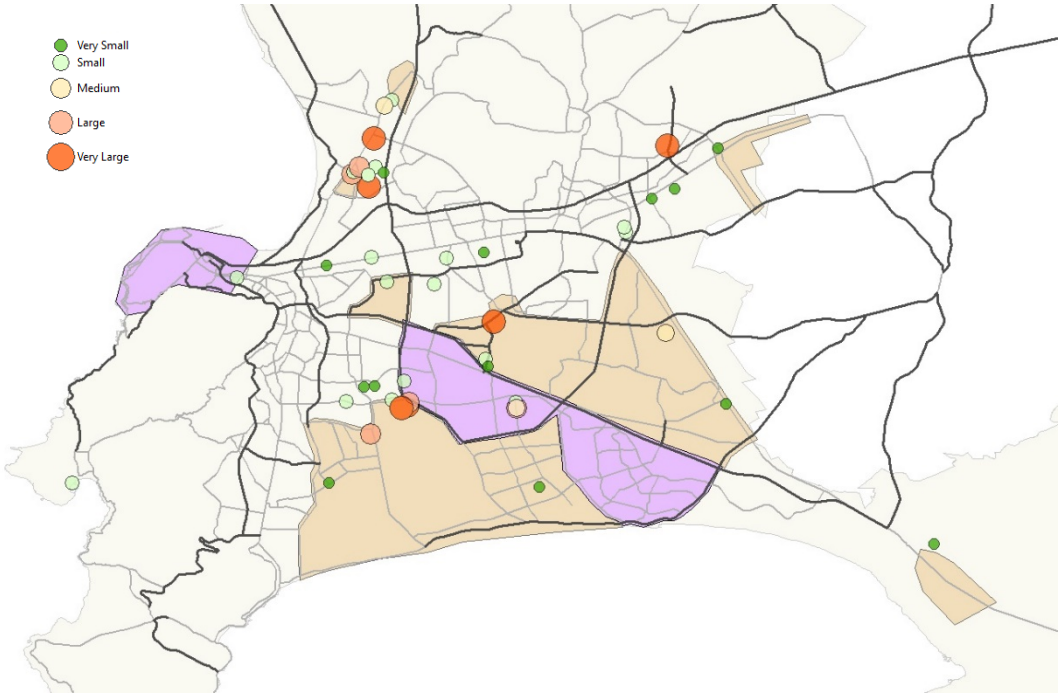


Figure 38: Potential civil unrest areas with distribution centres and wholsalers

The above figure illustrates that there are many sites in and around the combined areas of civil unrest, leading to the estimate of 44% of such sites being at risk to civil unrest. However, as can be seen from the following close-up of the above and the subsequent close-up of the informal settlements in the same area, the distribution centres and wholesalers are mostly outside and in-between the informal settlements and often located within business parks.

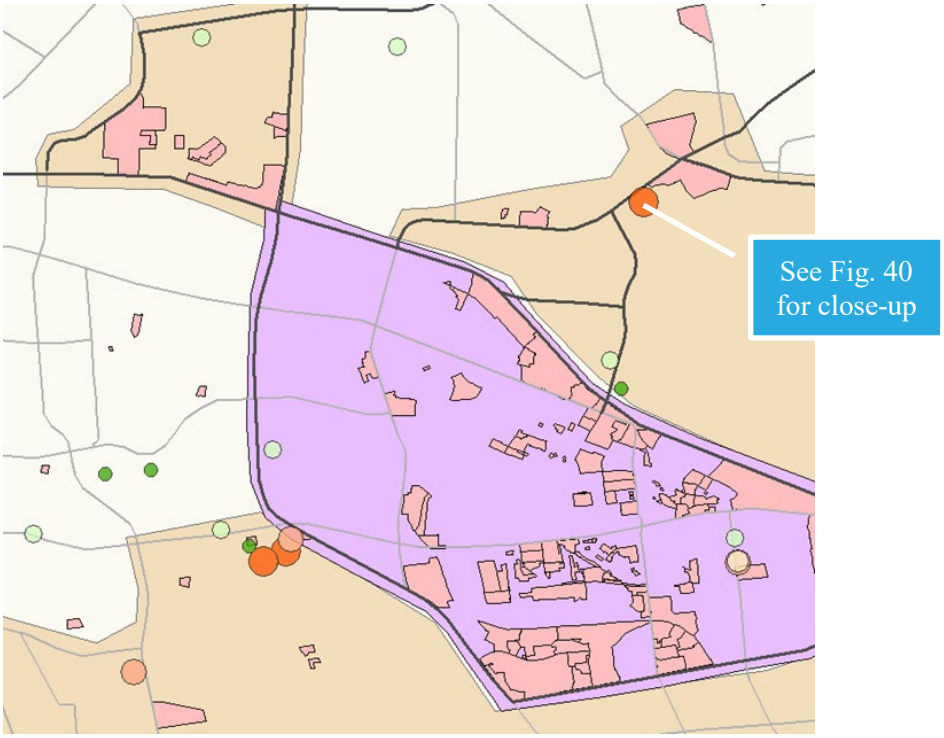


Figure 39: Distribution centres (orange dots) in areas of potential civil unrest

Figure 40: Distribution centre – top-right orange dot in Figure 39

The image above illustrates one distribution centre and the area surrounding, which includes several retailers, logistics service provider warehouses with areas of informal settlements between and in close proximity to the international airport.

It is considered unlikely that all the routes to and from this area will be compromised in a combined unrest scenario, however this is what has been assumed in the combined scenario.

5.2.4 Impact on food processors

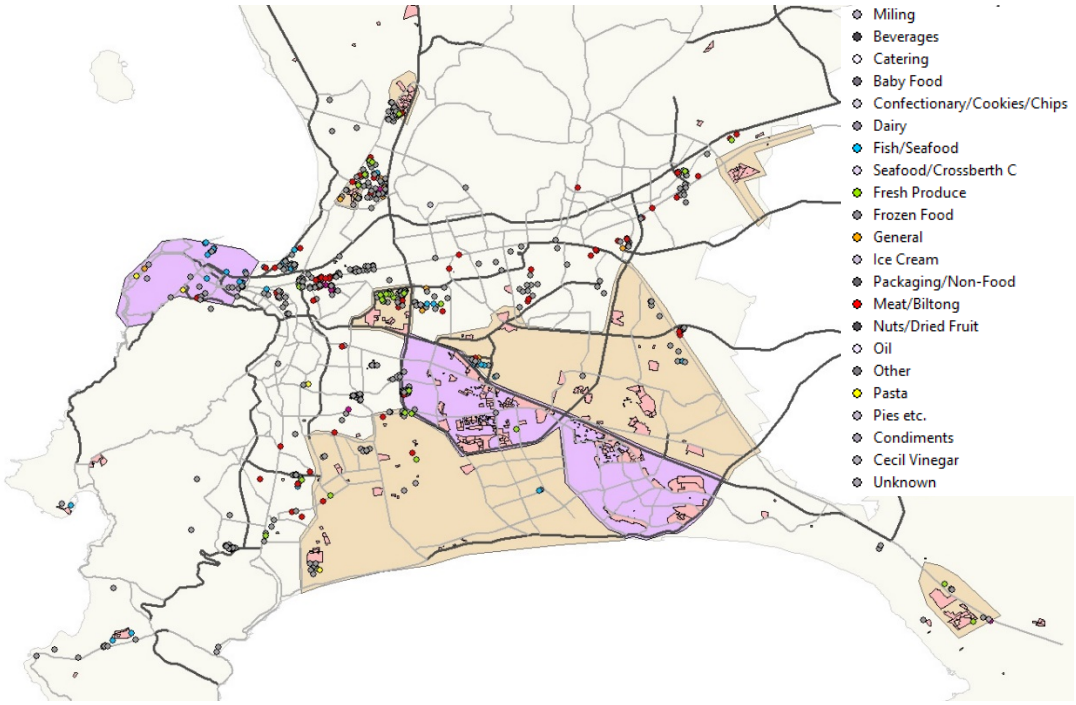


Figure 41: Impact on food processors during civil unrest

Like the distribution centres and wholesalers in the previous section, there are many food processors adjacent to informal settlements, but again mostly away from the immediate vicinity of the informal settlements.

The processors are dependent on flows of goods in and out. Protest and road blocks will directly impact some of them. Many of the business parks that have food processors are adjacent to informal settlements and are also dependent on the major arterial routes that are likely to be blocked off.

5.2.5 Impact on the fresh food market

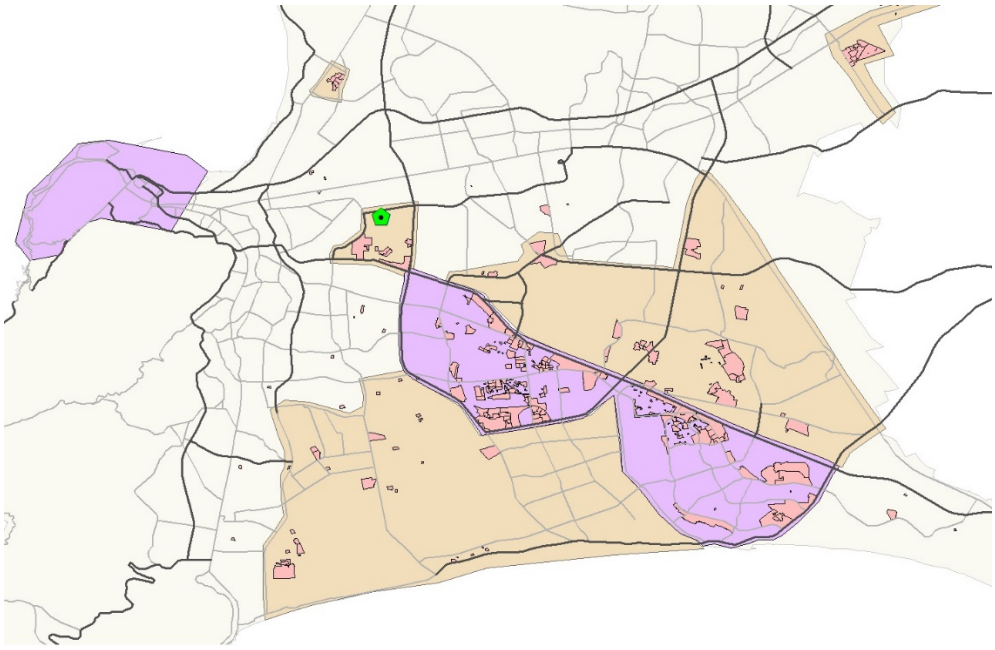


Figure 42: Impact on fresh produce market during civil unrest

The single fresh produce market can be seen to be in a similar position to some of the food processors (previous section) in being adjacent to informal settlements.

5.2.6 Impact on supermarkets

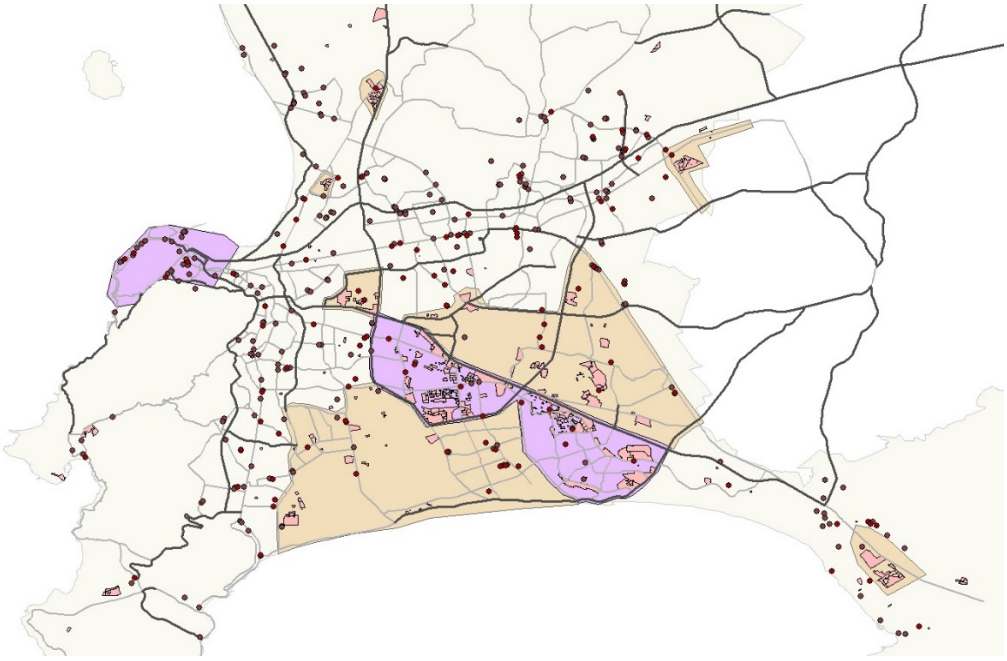


Figure 43: Impact on supermarkets during civil unrest

There is a proliferation of formal retailers in both areas of likely civil unrest. This is also amplified by the fact that population densities in these areas are very high – i.e. the number of people per formal retail unit is high.

5.2.7 Impact on rail

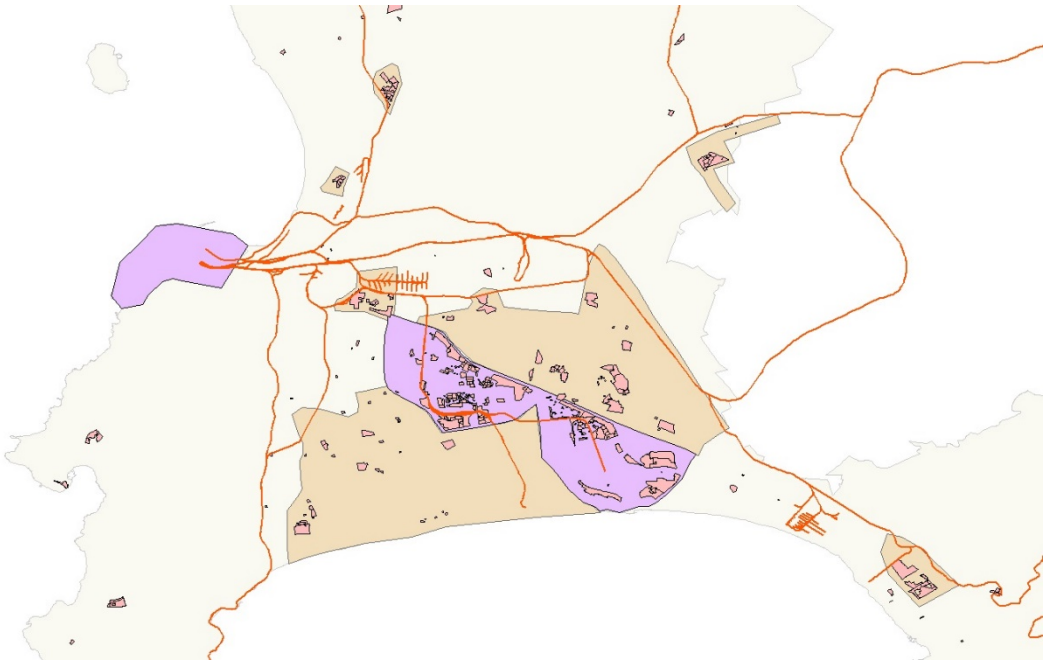


Figure 44: Rail lines running through the potential areas of civil unrest

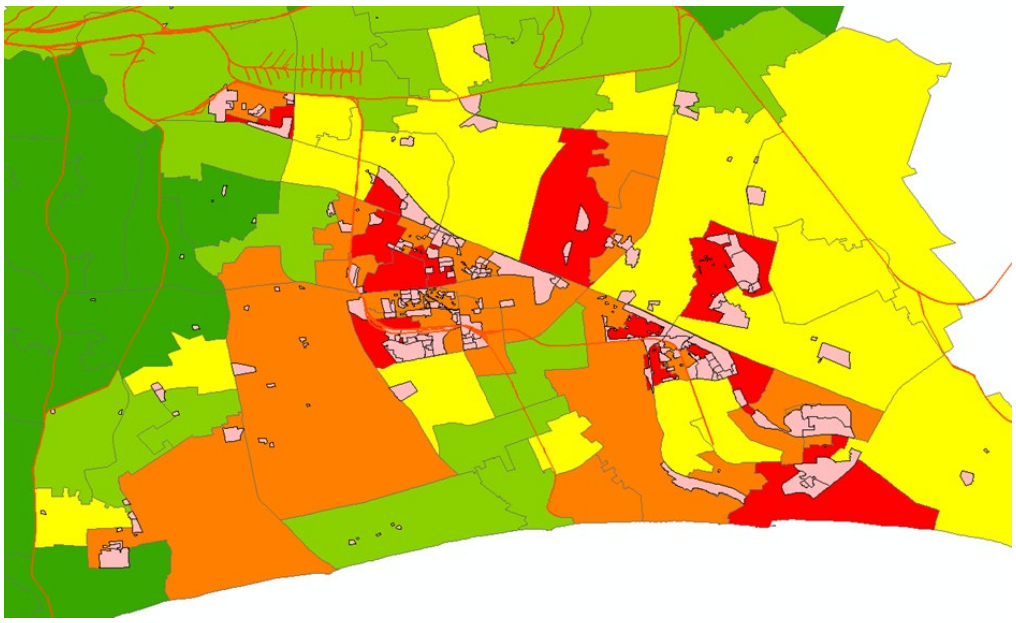


Figure 45: Zoom on areas of highest unemployment, informal settlements and the rail network

The percentage of the rail network impacted within the two unrest scenarios is 9% for the most-likely scenario and 17% for the combined scenario. As can be seen from these figures, rail lines do run through and directly adjacent to high crime, high unemployment and informal settlement areas. Protestors are aware that attacking the trains is a way to cause maximum disruption, especially as a single point of disruption will remove a whole line in most cases.

5.2.8 Summary of impacts

- Civil unrest will have an impact on the food system making access to food more difficult due to concerns over safety and possibly interfering with the production, processing, distribution of food within the city.
- Additional research is required to understand the broader economic impact of unrest to the food system, for example further understanding the employee profiles within the component of the supply chain (e.g. distribution centres or food processing centres) may reveal that people working in the centres reside in areas of informal settlements surrounding that would then be prevented from research the centres during impacted by unrest.
- A loss of between 11-23% of primary roads and between 13-30% of secondary roads is anticipated during periods of civil unrest. Alternative access routes may need to be investigated to ensure resilient supply.
- A theoretical loss of between 9% and 17% of rail lines, based on the amount of the rail line that are within the two unrest scenarios. This may lead to a significantly more of the rail network being unavailable as some of these will be in the middle of the network. The loss may be zero if rail lines are not targeted, however evidence suggests that rail lines are often targeted in Cape Town during periods of unrest.
- Significant additional congestion is likely on the remaining road network due to the above loss of roads and potential loss of part of the rail network.
- Near immediate loss of all the informal retailers within the informal settlements due to looting (e.g. xenophobic attacks). And limited capacity to travel elsewhere, or ‘outshop’, due to violence in taxi and bus sector.

5.2.9 Recommendations

Recommendations have been framed based on the working assumption that civil unrest is a regular occurrence and that there are few short or medium-term opportunities to reduce the incidence of unrest, especially given that it is often politically motivated. The following recommendations address the management of civil unrest events, and bare similarities to recommendations in the previous flooding scenario.

Priority	Category	Description	Ease / Time
1	Preparation Planning	**Identify impacted routes** for the most likely civil unrest scenarios and create pre-planned alternative routes that serve both expected commuting and food network requirements. Extend the **Walking Bus** principle in times of unrest to ensure safe access to food retail for residents of informal settlements. Also involve and promote **street committees** as an important component of safety and an example of how to address the risk of food insecurity for residents of informal settlements. Include knowledge gained from retailers such as during **work with retailers and wholesalers.** Include a pragmatic guesstimate of the expected impact on rail and the knock-on impact on congestion.	Easy Short
2	Planning Preparation Coping Recovery	**Work with retailers and wholesalers** to understand the details of their disaster recovery processes and create a combined strategy using other work in this section – such as *identify impacted routes* and *model the impact of civil unrest.* Look at encouraging behaviours that are mutually rewarding, such as: • Plan inbound stock movements with retailers during civil unrest – re-routing roads travelled and destinations • Stock movement and retailer manning at night to move replenishment outside of any congestion peaks. • Identification of other (non-critical) logistics e.g. construction that can be stopped or displaced to nights	Difficult Medium

3	Planning Preparation	**Model the impact of civil unrest** on congestion and average journey times / journey time variability of the expected, most expected, and most extreme civil unrest scenarios. Include rail and congestion with the expected displacement if rail is impacted. Modelling potential alleviating strategies, such as: • Increasing the already prevalent out of hours food replenishment to include all available night capacity on the road network. • Food / HGV only lanes, possibly the deferral of bus and taxi lanes to accommodate food transit. In addition to the need for some traffic modelling software, hard data describing movements will be required.	Difficult Medium
4	Planning Preparation	**Working with criminologists** to better understand the triggers for social protest and analysis of impact of past events. UCT's Safety and Violence Initiative may provide useful agents to pursue this.	Difficult Long
5	Planning Coping Recovery	**Manage resulting congestion** caused by civil unrest and possible rail displacement traffic by having in place: • Revised and additional MyCiti bus routes pre-planned to avoid the routes that are expected to be blocked and with additional capacity through extended running times and additional scheduled manpower. • If rail networks are substantially available, offer lower fares in the period(s) of flooding to reduce road congestion. • Other transport methods for the food network, such as pipelines, drone, boat / ferry. Or displacement of other traffic to these or other methods – such as monorail for passenger transport.	Difficult Short

6	Planning	**Identify required infrastructure changes** that will alleviate the increased congestion from regular civil disturbances. Additional roads, bridges etc.	Difficult Longer
7	Planning	**Partner with "big data" providers** such as Google to understand impact of SatNav programs on the flow of traffic in the city and the options available when normal routes are compromised. What will the SatNav engines do as the congestion escalates? Can anything be done to improve the way the algorithms work?	Difficult Longer

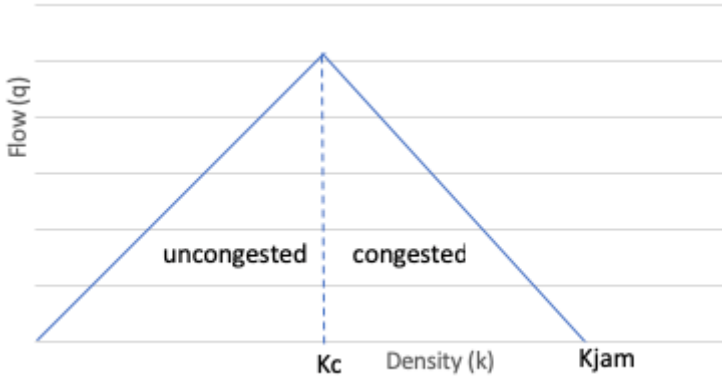
5.3 Scenario 3 - Transport network resilience

This final scenario assumes that the rail system is not operational. The road system will therefore need to be able to provide an alternative means of transportation in Cape Town for all rail users i.e. all the passenger journeys that are currently carried out daily on the rail system being moved to the road.

Between 2015/16 and 2016/17 passenger numbers on CoCT Metrorail reduced by 30% (2.7 million journeys), with approximately half of all commuter journeys being carried by rail and the other half by road.

5.3.1 Expected likely impact

No real assessment of the impact of such a significant change can be made without conducting traffic modelling of some kind.



However, traffic flow theory shows that after peak flow has been achieved, any increase in traffic density will reduce flow until zero flow is reached. Doubling the number of journeys on the road network with no compensating strategy can only lead to gridlock for all movements, not just the freight associated with the food network.

Ironically, gridlock also fundamentally changes how people eat given the time people must wait in traffic. We see in Cape Town existing clustering of informal

prepared food vendors around taxi ranks and train stations. In the absence of food preparation time, as it is cut into by extended commuting time, people are tending towards prepared foods (which are often more expensive and less healthy). A possible longer-term resilience plan is to crowd in healthier prepared options into the system - if we are looking at a resilient food system being one that ensures food and nutrition security. Or alternatively efforts can be targeted at removing the congestion that drives the behaviour.

The only way to gauge the likely impact(s) of such a significant move of journeys from rail to road would be to create a strategic model of the City of Cape Town traffic flows or modify an existing one with the expected additional volume. To manage simulation run times the road network is only modelled at an aggregate level of detail. Traveller and vehicle demand are usually defined in person trips and is derived from demographic census data and observed trip making behaviour from surveys. Mode choices in this case would be between different types of road vehicle, such as: -

- Car
- Small car-based taxi
- Small minibus / taxi
- Larger private bus / taxi
- MyCiti bus

This would require some assumptions about the likely availability of different types of bus. It would also be possible to model larger bus sizes on routes to accommodate the additional journeys, increased frequency and earlier and later operating times to meet demand.

Unlike the modelling suggestions in the other two scenarios, which would be more likely achieved with Highways Traffic Assignment (HTA) tactical modelling. This type of modelling is designed to predict the impact of area wide road-based trip diversion and route choice. As an alternative, this type of modelling analysis can be used to conduct an operational assessment to indicate the impact of a short-term change on the network. Data required would be capacity, journey times between nodes and some top-level assumptions about mode choice.

5.3.2 Recommendations

Priority	Category	Description	Ease / Time
1	Preparation	**Minimise property damage and crime on the rail system –** It is understood that the second half of 2018 has seen a reduction in train fires, infrastructure damage, and other crimes. The formation and deployment of the Rail Enforcement Unit (REU), a specialist policing service, in 2018 appears to have had a significant contribution to this. Additional REUs are planned to be introduced in 2019. **Introduce integrated public transportation:** Integrated ticketing across the MyCiti and rail system may provide an effective entry point to closer integration of public transportation systems. Besides encouraging cross-modal journeys among residents and building redundancy in the public transport system, effective rollout and delivery of integration mechanisms may provide an opportunity to include informal and independent public transport providers like minibus taxis within the public transport system. The integration of minibus taxis is likely to be key and may be achieved through the use of networked application technology – something like a CoCT internal Uber system that links train, bus and taxi users for integrated journeys.	Difficult Longer
2	Planning Preparation	**Model the impact of rail failure** – as described in the section immediately above, looking at the options of bus sizes, operating hours, frequency etc to select the best-balanced strategy In addition, if the rail system fails there will still exist pathways through the city with bridges and other infrastructure that could be re-used for high speed guided busways (for example) – this could also be modelled.	Difficult Longer
3	Planning Coping Recovery	**Manage the resulting congestion from rail failure** – by a combination of initiatives: • Revised and additional MyCiti bus routes with additional capacity through extended running times and additional scheduled manpower / more frequent running times. Possibly larger buses on	

		some popular routes to reduce overall road congestion. • Integrate the private minibus taxis within the larger system to minimise congestion and emissions.	
4	Planning Preparation Coping	**Work with retailers, wholesalers and other** freight road users to understand their needs and ability to be flexible about when they use the road network. Schedule an increased number of freight deliveries outside of peak commute times and encourage maximum vehicle fill and full return loads. This is essentially extending the Woolworths stock maximisation initiative to other retailers.	Easy Medium
5	Planning Preparation Coping	**Look at the feasibility of road charging**, This could be used to drive the use of particular types of vehicles at times of the day that would reduce the overall level of congestion – including enforcement options.	Difficult Medium

6 Key opportunities

This section presents the key opportunities that have been identified by the research team based on the desk-based technical scenario analysis.

A unique feature of the food system is that its resilience is shaped both by the system itself and by its individual users in ways that other basic services, such as electricity, water and sanitation are not. In other words, urban consumers play an important role in enhancing the resilience of the food system and are not passive recipients of services offered by the system. This therefore provides further opportunities for the City to frame its resilience strategy regarding the food system and food security.

The City therefore needs to consider how it is that consumers use their agency in the food system to draw maximum utility from the system and seek to enhance that. This can enhance food security and improve the livelihood and employment generation capacity of the food system. The City's food system resilience response therefore needs to focus both on the food system itself and on the lived experience of that system through Capetonians.

The following sections provide both general and scenario-based recommendations following the results of the scenario analysis.

Note: there may be some practices that have worked in jurisdictions outside of Cape Town may not be currently supported by existing policy or regulations. Further policy and regulatory discussion may be required before these ideas will be viable options in Cape Town.

6.1 General opportunities

The following general opportunities for enabling an improved food system in Cape Town may be considered by CoCT's resilience office to shape actions under the fifth pillar, 'Collaborative, forward-looking City'.

- **Articulating a municipal food mandate:** The right to food is a South African Constitutional right (Section 27.1.b), and government is obligated to ensure the progressive realisation of the right to food. However, local government has not understood itself to have a food mandate, and the role of local government in ensuring this right is not clearly articulated within the Constitution nor in other Acts guiding municipalities.

  Articulating a municipal food mandate will provide a legal basis for actions to enhance food system resilience.

- **Filling data gaps within the food system:** There appears to be little data collected within government on any component of the Cape Town food system. This is largely the outcome of historical framings of the South African food system and the resultant government mandates. As a result, CoCT is dependent on datasets generated for other purposes to carry out a food system analysis (e.g. addresses of food processors held by the Environmental Health department) which may not be suited to purpose, or on data generated by academics for research purposes, often limited to a case study and unsuitable for a holistic understanding of the system.

  While there is sufficient data to identify critical points of vulnerability, it is recommended that CoCT identifies and fills data gaps in order to obtain a holistic understanding of the food system. See Section 5.2.1 for further detail.

- **Engaging food system decision-making for integrated data-driven decision-making**: Unlike most other basic service systems in the city (e.g. water, sanitation, energy) food is largely delivered to urban residents through private sector activities. This requires partnership with private sector actors (both formal and informal) to consolidate fragmented data and utilise this data to enhance food system resilience. Large private sector actors (for example the supermarkets and food processors) hold significant data that has informed their decision-making. CoCT should consider engaging with these actors to understand the feasibility of data-sharing to inform decision-making.

- **Influencing food choices:** To a large extent, the resilience of the food system relies on the choices and decisions made by the system's users – the residents of Cape Town – and cannot be attributed solely to the characteristics of the assets that constitute it. City residents require information and incentives to navigate the food system to effectively enhance resilience to food insecurity.

  CoCT should consider social interventions that help influence individual and community food choices and behaviour.

6.2 Scenario-based opportunities

The following is a summary of the opportunities made against each one of the three scenarios, and some more general points that cover the approach to the resilience of the food system.

6.2.1 Opportunities around data

1) Opportunity to collect better food data as part of the standard city data collection efforts. This requires strategic oversight on what data is required to assist the city in making better informed food system resilience decisions.

   Where this is beyond the capacity of the City, the City should seek to partner with one or more of academia, big data, transport modellers, or specialist supply chain consultancies to generate this data in a form that is useful for further analysis to inform decision making.

   The City needs to convene dialogue with large scale private sector actors to create a data sharing agreement on key components of the food system. This will be mutually beneficial. It will assist the City in decision making and will enable private sector to make their case to the City around requests for special consideration (for example, if a bread company wants to argue that they should be exempt from load-shedding as their bread is an essential service, they need to be able to provide contextual data to support this case).

   Further the City needs to proactively seek to include data from informal sector actors (as key components of the food system) into the data sets on food systems. Food sector specific workshops should be held with key representatives from the informal sector to increase the City's understanding of this sector.

2) Use forecasts and seasonal data to predict floods and plan key preparatory work (see seasonal work below) to ensure correct equipment, manpower, skills available, and to prepare signposts and information highlighting alternative routes. Use this data to:

   a. Schedule and resourced preparatory work such as clearing storm drains, flood water outflows, storm water inlets, open drains, dredging water course that drain areas prone to flooding.

   b. Especially where the work will ensure clear roads.

   c. Proactive consideration of the solid waste management to see if there are challenges that shape waste behaviour in informal settlements, which then leads to pollution down storm water drains.

3) Opportunity to model the impact of all three scenarios on congestion and average journey times / variability of the most expected and most extreme

possible outcomes. Include the impact of rail and congestion from the expected displacement if rail is impacted.

Modelling potential alleviating strategies, such as:

a) Increasing the already prevalent out of hours food replenishment to include all available night capacity on the road network.

b) Food / HGV only lanes, possibly the deferral of bus and taxi lanes to accommodate food transit.

In addition to the need for some traffic modelling software and expertise, this is an example of where the hard data described in (1) above will be required.

4) Either from the modelling (above) or more intuitively, identify impacted routes for the most likely flooding scenarios and create pre-planned alternative routes that serve both expected commuting and food network requirements, including:

a) Knowledge gained from retailers such as during work with retailers and wholesalers.

b) A pragmatic guesstimate of the expected impact on rail and the knock-on impact on congestion.

5) Long term forecasting of the expected changes in flooding based on climate change modelling, to inform. Likely to be partnering with climate change specialists. This can inform and of the planning and preparedness activities in this section.

6) Partner with “big data” providers such as Google to understand impact of SatNav programs on the flow of traffic in the city and the options available when normal routes are compromised. What will the SatNav engines do as the congestion escalates, and can anything be done to improve the way the algorithms work.

6.2.2 Opportunities around private enterprise

7) Work with retailers and wholesalers to understand the details of their disaster recovery processes and create a combined strategy using other work in this section – such as identify impacted routes and model the impact of flooding. Look at encouraging behaviours that are mutually rewarding using the forecast data available, such as:

a. Increase stock in retailers, distribution centres and wholesalers that are not expected to be impacted prior to expected seasonal floods.

b. Plan inbound stock movements with retailers during floods – re-routing roads travelled and destinations.

c. Stock movement and retailer manning at night to move replenishment outside of any peak.

d. Identification of other (non-critical) logistics e.g. construction that can be stopped or displaced to nights.

8) Opportunity to test resilience plans in key sites, such as Epping Industrial (home of Cape Town Fresh Produce Market, and other food companies and food logistics companies), Spar and Pick n Pay Distribution Centres in Philippi, the node of cash and carry wholesalers in Bellville and Bellville Taxi Rank, and one or two low income areas where substantial research has already been conducted by food researchers.

9) Opportunity to create contingency plans building on the modelling in this report or more intuitively, to identify impacted routes for the most likely flooding scenarios and create pre-planned alternative routes that serve both expected commuting and food supply requirements. This could include:

a) Knowledge gained from retailers such as during work with retailers and wholesalers.

b) A pragmatic guesstimate of the expected impact on rail and the knock-on impact on congestion.

6.2.3 Opportunities around city governance

10) Mainstreaming food: While the City has no direct mandate to address food security, it plays several important roles in the form and functioning of the food system within Cape Town. The City plays a direct and indirect role in many components of the food system, including production, processing, distribution, sale, waste management and safety.

11) Opportunity for the city to design programs or incentives to encourage people not to waste food partnering with local NGOs or community/neighbourhood organisations. For example, the City can provide incentives for restaurants to donate unsold food to vulnerable people or to encourage customers to take their leftovers with them home or work with chefs or households to design recipes with leftover foods.

12) Additionally, the City's existing policies and programmes impact upon the household's ability to access and utilize food. The Resilience Office should work to encourage food sensitivity to be embedded in core activities of the City. Officials should be encouraged to consider the food system resilience impact of sectoral and area plans. For example, in planning for new industrial parks (which are key sites for food processors), what infrastructure provision might be considered to improve the functioning and resilience of the food system activities taking place there? How might transport plans be improved if

the realities of food haulage were considered? How might food security and viable food systems be incorporated into re-blocking plans?

13) Look at the feasibility of road charging. This could be used to drive the use of certain types of vehicles at times of the day that would reduce the overall level of congestion – with enforcement options.

6.2.4 Opportunities to work with residents, small independents (including informal retailers) and growers

14) The urban poor spend a large proportion of their income on food further adding to issues of food insecurity for the most marginalised urban communities. Opportunity for the City to play a convening role, bringing together partners (public, private, civil society, academic) to provide improved financial and physical access to affordable and nutritious food particularly within informal settlements and low-income urban communities.

15) Opportunity to conduct detailed planning for food security in informal settlements that is inclusive of informal retailers and that pays specific attention to implementation.

16) Opportunities exist to create specific strategies to enable physical access to food, e.g. a social response such as the Walking Bus during times of civil unrest or identified safe locations during flood events where residents can access food. Working in partnership with local food research institutions like the ACC or the Sustainable Livelihoods Foundation and residents (particularly poor and vulnerable in informal settlements) to understand how physical accessibility to food is impacted by shocks and stresses and to identify settlement-specific coping mechanisms.

17) Opportunity to partner with the Informal Trade Unit and using the annual informal economy summit to engage with informal retailers to advise them of the best forecast estimates of flooding and agree strategies for moving their stocks to other areas in advance of any flooding (use forecasts and seasonal data) which have been selected. Possibly also working with trader associations and using key wholesalers (e.g. CTFPM and MAKRO) as points of information dissemination.

18) Opportunity to work in partnership with the City Disaster Management team to think about what practical assets might be supplied to prevent households losing food in a flood event, such as heavy-duty plastic storage containers.

19) Opportunity to diversify and promote organic farming which can then be marketed in low-income neighbourhoods within the city, to promote healthy food, activate public space and contribute to social cohesion and economic activity in vulnerable areas. One example of this are the new markets established at the microscope in Khayelitsha - efforts should be made to support these.

20) Opportunity to consider the combined role of tourism and food. The opportunity for local food tourism and enhanced social cohesion celebrating the best of informal food retailers and cuisine. Some emerging examples include 4roomed Ekasi culture, Mzoli's, and the Langa Quarter.

21) Opportunity to support and enhance natural agricultural systems to help with alleviating floods, for example developing guidelines or policies for sustainable farming to work with nature and linking to wider initiatives in water sensitive urban design and landscaping.

6.2.5 Opportunities overlapping groups

22) Working with the food system that you have: The current food system in Cape Town has a degree of robustness and resilience which is the outcome of the inherent diversity of the food system. Formal and informal retailer have diverse sourcing strategies, logistics, and geographies. This diversity provides some inherent resilience, which is further enhanced by mobility and knowledge networks of consumers. However, this secondary resilience of consumers is undermined by multi-dimensional poverty, instability of the public transport system and access to basic services. Both formal and informal provide benefits to the City and its residents and resilience planning should seek to support both.

    The recommendation is essentially to work mindful of the benefits that the different sectors provide. There has been a history of strong regulation of informal trade with little consideration of the essential role and added resilience benefits of the informal food system.

    Multi-sectoral consultations need to take place with sector specialists to consider and fully understand the complex system interactions across and between sectors. For example, understanding economic, employment and livelihood considerations, education and health, etc.

23) Plan how to manage resulting congestion caused by each scenario by:

    a. Revised and additional MyCiti bus routes pre-planned to avoid the routes that are expected to be blocked and with additional capacity through extended running times and additional scheduled manpower.

    b. Encourage off peak travel, for example working with Western Cape Education Department to investigate staggering school starts.

    c. Introduce joined up City Bus and Train services with integrated ticketing to encourage cross- modal journeys and more efficient transport services for the CoCT resident that encourages them to support public service infrastructure.

d. Better integrate the minibus taxi into the whole transport network to improve both congestion and emissions.

24) Improve robustness against flooding of the food network by identifying works on roads, rail and flood defences that will alleviate the most impacts of the flooding for the projected available funding available. Combined with the best guestimates from identify impacted routes, or the more scientific model the impact of flooding on congestion.

25) Minimise property damage and crime on the rail system – It is understood that the second half of 2018 has seen a reduction in train fires, infrastructure damage, and other crimes. The formation and deployment of the Rail Enforcement Unit (REU), a specialist policing service, in 2018 appears to have had a significant contribution to this. Additional REUs are planned to be introduced in 2019.

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